Government of India

Ministry of Water Resources, River Development and Ganga Rejuvenation

National Water Mission

Central Water Commission

DFID

Asian Development Bank

Policy and Advisory Technical Assistance 8089 IND Phase II

Operational Research to Support Mainstreaming of Integrated Flood Management under Climate Change

Volume 6a

Community Survey Report: Burhi-Gandak

Final

December 2015

Deltares in association with RMSI and JPS

Cover photo:

Panchayat constructed bridge across Gandak River in Sonpur and community consultation in Odisha and Bihar

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Abbreviations

ADB	Asian Development Bank
BB	Brahmani-Baitarani
BG	Burhi-Gandak river basin in Bihar
CBO	Community Based Organization
CHC	Community Health Centre
CSR	Corporate Social Responsibility
CWC	Central Water Commission
DDMA	District Disaster Management Authority
EWS	Early Warning System
FGD	Focus Group Discussion
IFM	Integrated Flood Management
IMD	Indian Meteorological Department
NGO	Non-Governmental Organization
NH	National Highway
NRSC	National Remote Sensing Centre
OBC	Other Backward Classes
PHC	Public Health Centres
RFIS	Reliance Foundation Information Services
SC	Schedule Caste
SDMA	State Disaster Management Authority
SHG	Self Help Group
ST	Schedule Tribe
WRD	Water Resources Department

Units

MWh	Mega Watt hour – unit of Energy
m	Metre – unit of Length
cm	Centimetre – unit of Length
mm	Millimetre – unit of Length
Cumec	Cubic meters per second – unit of Flow
km	Kilometre – unit of Length
Sq.Km	Square Kilometres – unit of Area

Executive summary

This community report is prepared as part of the PATA-8089 IND Operational Research for Mainstreaming Integrated Flood Management under Climate Change Phase II. The objective of this operational research project is to demonstrate that flood risks can be reduced through a broad mix of flood management measures, typical for the Indian context, with specific considerations for Climate Change. The project also aims to demonstrate to central and state governments the benefits of such an integrated flood management and planning process, and to provide guidance on such planning process, to translate results into updated CWC guidelines and regulations relevant for future DPR approval.

The key focus of the community sub-component of this assignment is to assess the flood-related issues the community is facing and their needs, and develop a proposal for mainstreaming the community needs and initiatives into IFM and reflect this in an inclusive IFM planning process.

The methodology adopted for understanding the community needs and problem include consultations and household survey. The analysis of the information collected through these field based activities was supplemented by secondary data including census data, hazard and loss data available at the state.

There are 11 districts and 171 talukas in the BG basin with a total population of 35.6 million and has a population density of 1,316 person/sq km. The density of population more or less homogenous across the basin. However, the basin has the district which has the highest density in the State - Sheohar district. The population density varies from 753 person/sq km to highest density of 1,880 person/sq km. The majority of the population in the basin are general category and the Schedule Caste (SC) and Schedule Tribe (ST) population contribute together of on 16%. The literacy rate of the basin is lower (48%) compared to that of the State average of 61.8%. Illiteracy rates are higher among ST followed by SC population.

The average household size is 5.5 persons with SC and ST with higher than the average household size. About 25% of the population are of age <6 and >60, while population between age 6-16 constitute 29%, are dependant population. Agriculture is the key livelihood with Kharif crop (rice) as main crop and is the key income source for the rural population. Large number of people work as agricultural labours. There is substantial % of population living in kutcha house with an average monthly income of INR 3,000 - 5,000 and INR 5,000 - 10,000. The higher income groups are mostly general category and SC and ST community are mostly in the lower income.

The kutcha houses don't have much household assets. About 23% of the households only have TV and are mostly with the higher income group. However, almost all the household has cellphone and many houses have more than one cellphone. Household keep livestock are asset and economically better off people keep buffaloes and poor keep goats.

BG basin has embankment all along its course. The river carry lot of sit and silt deposit cause problem like waterlogging in the mid and downstream of the basin. People like in pucca structure on the river side of the embankment. About 33% of the household surveyed are on flood plain while there are large number houses mostly kutcha houses constructed on the newly deposited river bank locally known as "*Char*".

The community in the basin has reasonably good access to roads. However, the rural population has poor access to health facility. The drinking water and sanitation facilities are also poor in the basin. More than 90% of the population depends on tube well for drinking water. The toilet coverage is very poor in general in the state as also in the basin.

Floods occur in BG basin is mainly due to heavy monsoon rain. Most of the floods occur during the months of July to September with heavy casualty of human life and loss of agriculture and assets. The intensity and frequency of flood in the BG has reduced since 2007. This is also reflecting in the loss statistics as well as during the field consultations. The 2007 flood has severely affected the state which includes many of the districts of the basin.

The key cause of flood in the basin is due to heavy rain and often due to overtopping of flood water over the embankments. There are several instances of embankment breaches, and some instances of people deliberately breaking the embankment to save their village (downstream). As per the survey the flood heights in the majority of the flood events varies from < 0.5 m and 0.5-1 m with less area affected by more than 1 m flood height. The flood water stays for longer duration of 25-30 days with some area even up to 60 days particularly in midstream. Flood recedes downstream faster.

The river carries heavy silt which causes serious environmental problems including water logging, and silting of irrigation channels. The silting of channels sometimes chokes sluice gates, thus leading to non-operation and abandoning of the irrigation system. The flood in the basin affect a narrow stretch of area in the basin. As per the community, since the water from Bagmati river stopped flowing into the BG river, the frequency of flood has reduced in the basin in the last 10-15 years. Floods cause health problems - mainly water borne diseases due to unsafe drinking water and poor sanitation conditions. The state has constructed a large number of tube well with hand pumps on the embankment. However, these are not adequate. There are inadequate flood shelter facilities and during flooding people resort to embankments, elevated roads and roof of pucca buildings.

The community level preparedness for flood management is very poor. The communities try to prepare themselves to their own capacity to protect their family from flood. The existing EWS is not very effective and people devise their own mechanism to observe flood hazard locally and take decision on their own. Communities are not involved in any flood management or local planning exercise. The level of literacy is a key factor for poor awareness and less involvement of community in flood management activities.

It is important to understand the community specific needs and problems and this needs to integrated in the IFM planning process. The key elements that need to consider while developing the strategies includes:

- Flood mitigation interventions should be acceptable to the community and not totally alien to the system for ease of adoption;
- Introduction of alternate livelihood or crops needs market analysis and ensure mapping of the whole supply chain;
- Any introduction of technology for developing adaptation or coping mechanism should not depend too much on external skills as this will be a threat for the sustainability;
- Identification of locally tested indigenous options for adaptation and coping mechanisms;
- Should have net benefits independent of any hazard. Some adaptation options may yield net benefits even without occurrences of any hazard and that need to be encouraged;

- Analyse the barriers for implementing strategies and work effectively to address the same.

Following are the key summary points based on the analysis of the community survey and consultations.

- The frequency of flood hazard has reduced in the basin during the last 10-15 years. The flood affect livelihood (particularly agricultural crops). The number of human and livestock casualties is showing a decreasing trend during the last decade which is encouraging.
- The population density in the basin is pretty homogenous and the vulnerability of the community varies with the economic capacity.
- It takes about 25-30 days for flood to recede from the agriculture field particularly in the midstream of the basin with some locations experiencing about two months of standing flood water. The settlements are mostly in elevated area and are less affected by flood.
- The community needs and problems are distinctly different in the up-, mid- and downstream parts of the basin.
- Basin level coordination is required for effective flood management.
- Waterlogging is a key problem both in midstream and downstream of the basin. Upstream of the basin has water scarcity problem as well in addition to flash flood.
- Poor maintenance of embankment sluice gates in the canal are also cause problems related flooding and lack of water during non-rainy season.
- Poor sanitation conditions, lack of drinking water, availability of fodders and shelters are the key issues community face during flood season.
- The community preparedness for flood risk management is poor and community tend to prioritise livelihood to risk to flood.

Following are the key suggestions for developing strategies for community involvement in IFM activities:

<u>Planning and implementation of mitigation measures</u>

- As community needs and problems are very specific to river basin. The State WRD and CWC should carryout community need assessment priority to any major intervention projects.
- The State WRD and CWC should make it as a mandatory to conduct community consultations to ensure acceptance of community before finalisation of any project to implement.
- SDMA should prepare and publish flood hazard maps so that community will have a good understanding of the flood risk of area they are living of investing for businesses.

<u>Preparedness</u>

- District Disaster Management Authority (DDMA) needs to take active role at sub district including village level for developing awareness and keep the community level DM committees active.
- State through State Disaster Management Authority (SDMA) and DDMA need to identify and mobilise NGOs and CBOs to involve in sensitizing and mobilising community based activities for flood management.

- State WRD should have a properly enforced mechanism for maintenance and surveillance of embankments and O&M of sluice gates in the channels. Provisioning of adequate budget needs to be identified during annual budgeting. Community DM committees should be part of the monitoring and surveillance and should also be engaged for the maintenance activities to ensure ownership.
- The local administration representative should be part of the DM committees and should ensure that these committees meet at least once a month. Local administration needs to ensure local DM committees are active and follow the defined roles and responsibilities.

Protect livelihood to improve resilience (adaptation measures) specific to BG basin based on existing issues

- State agricultural department should promote flood/drought/salt tolerant varieties of rice to suit to the changed situation of the agricultural land.
- State agricultural department through its extension services should encourage farmers to switch to crops other than rice including short duration cash crops in the flood prone areas to protect their livelihood. However, while identifying alternate crops, supply chain of crop produce needs to be mapped and ensure that the suggested alternate crop produce has adequate market.
- State agricultural department through its extension services should provide alternate livelihood options suitable in waterlogging conditions. However, while identifying alternate crops, supply chain of crop produce needs to be mapped and ensure that the suggested alternate crop produce has adequate market.
- State agriculture department through farmer cooperatives and agri-business companies should promote crop insurance as safety net for the community.
- State WRD in coordination with CWC and IMD should improve the effectiveness of early warning system to reduce the flood risks.
- State agricultural department should providing agro-advisory based on weather forecast (for season) can help farmers to plan their agriculture calendar.
- State Revenue Department in coordination with WRD should enforcement strict landuse practices on the river side of the embankment (no permanent structures) to reduce casualty and loss.
- Local administration with the support of local NGOs/CBOs should work with communities for developing drainage channels in waterlogging areas to make the land suitable for agriculture.
- The local administration should utilise the development funds along with community contribution and participation to construct drainage channels to resolve localised waterlogging issues.

Chapter 1 Background and Organisation of the Report

The PATA Operational Research for Mainstreaming Integrated Flood Management under Climate Change was included in Asian Development Bank (ADB)'s country operations business plan, 2012-2014 under the 2012 pipeline in December 2011. The ADB fact-finding mission was conducted on 15 February 2012 and 9 March 2012 to consult the Government of India on the preliminary design of the TA, including expected impact, outcome, and outputs: the financing modality; cost estimates, and implementation schedules and arrangements. Thus the present PATA-8089 IND has emerged. PATA is co-financed by UK aid, whereas the executing agency is the Ministry of Water Resources.

PATA is implemented in two phases. It started with Phase I from March to August/October 2013 which comprised Scoping and Planning studies. The present Phase II addresses and elaborates the Operational Research to support the mainstreaming of Integrated Flood Management (IFM) in a way that takes into account projected future conditions and climate change uncertainties. This phase is scheduled for 18 months with effect from 19th February 2014 till 31 October 2015.

The overall objectives of the study are:

- *To demonstrate that flood risks can be reduced through a broad mix of flood management measures, typical for the Indian context, with specific considerations for Climate Change;*
- *To demonstrate to central and state governments the benefits of such an integrated flood management and planning process;*
- *To provide guidance on such planning process, and*
- *To translate results into updated CWC guidelines and regulations relevant for future DPR approval.*

The objectives encompass the combination of structural and non-structural measures as well as increasing the resilience of the communities in flood prone areas of the two selected basins (Burhi-Gandak and Brahmani-Baitarani), such that the selection of such measures can be replicated or adapted in other basins/sub-basins. The selection process should enable the evaluation of investment programs based on scientific reasoning and economic efficiency.

This report "Community Survey Report Burhi-Gandak, volume 6 (Part 2)" is one of the series of reports presenting the study findings of the community sub-component of the Burhi-Gandak (BG) basin. The Part 1 report provides the study findings of Brahmani-Baitarani (BB) basin.

The objective of the community sub-component of this assignment is to assess the flood-related issues the community is facing and their needs, and develop a proposal for mainstreaming the community needs and initiatives into IFM and reflect this in an inclusive IFM planning process.

As part of this report, we have covered the following key aspects of the basin:

- A review of community flood issues, practices, and needs in the two sub-basins, based on extensive consultation and participatory appraisals (D24);
- Identification of potential pilot projects to increase flood resilience and coordination with potential implementing partners (D25);

- Synthesized outputs of the community needs to support the preparation of flood management strategies and the IFM plan for the focal sub-basin (D26);
- Proposals to mainstream community needs and initiatives into IFM and reflection in an inclusive IFM planning process (D27).

Chapter 2 Introduction

Impact of flood on communities can be broadly categorised into losses to life, assets, and livelihoods. However, the characteristics of floods and how they affect the local communities varies from river basin to river basin. For the same reason, the community needs also vary from basin to basin. During the field investigation, we found a variation in community problems and needs within the basin as well, since floods impact upstream and downstream communities differently.

The Phase 1 Report documented the IFM best practices across the world and flood management practices in India in detail. It also provided a separate section on community based flood management in the country. These sections documented some of the recent projects implemented in the country which have community components for disaster management. It is apparent from the review of these projects the importance of community involvement in flood management is well recognised in India and several initiatives have already been taken in this direction.

2.1 Methodology adopted for identifying community flood issues and needs

A two-pronged approach was adopted to collect community based information – community consultation through Focus Group Discussion (FGD) and household survey. The purpose of these community based activities is basically to collect first-hand information on the localized issues, needs and community perception on flood hazard and associated risk, community preferences on structural and non-structural interventions for flood management. While community consultation provides a larger picture of the community in general, the household survey provides household specific information, including losses and damages caused by flooding.

2.1.1 Focal Group Discussions

FGDs were carried out in 5 villages each in the basin. Out of these 5 FGDs, 2 were exclusively among women's groups. The women's group consultations help in understanding the gender issues, difference in the perception of men and women towards various flood management issues and activities, specific needs and priorities, etc. The districts and villages within the district for FGDs were selected across the basin and covered the upper, middle and lower reach of the river. This is important as the issues and needs are different in these river stretches. The upper stretches do not have many issues related to flood but probably have issues related to lack of water availability for agricultural purposes.

The FGDs were conducted using guiding questions and followed the key rules of community consultations. The team visited the village identified for the FGD one day ahead of time and informed the important people in the village regarding the intent of the community meeting and invited the community for the meeting with the support of these people. People from different age groups, both male and female, were invited to participate for the meeting.

2.1.2 Household survey

The community consultations (FGDs) were supplemented by household surveys. Stratified random sampling method was adopted for the selection of the samples across the basin. Total of 350 households were surveyed in which samples from rural and urban areas were included. Out of the 350 households, 300 houses were surveyed in rural areas in 15 villages across 3 districts and 25 households each in two urban areas in each basin. The districts were selected in the upper, middle and lower reaches of the basins. Economic strata is considered while selecting the household and this was done by considering the house type as key criteria. Based on the composition of kutcha, pucca, and semi pucca houses in the census data, similar percentage composition of houses were considered (60-20-20 respectively) while selecting the sample for the household survey.

The survey was administered through a pre-tested structured questionnaire (Annex). The survey was conducted with the help of trained surveyors hired locally. The survey activities were supervised by the community experts and regular quality checks were carried out during the course of the survey. The data collected were later tabulated and analyzed to understand community profile, needs, and issues. Figure 2-1: Locations of community surveyed in BB basins.

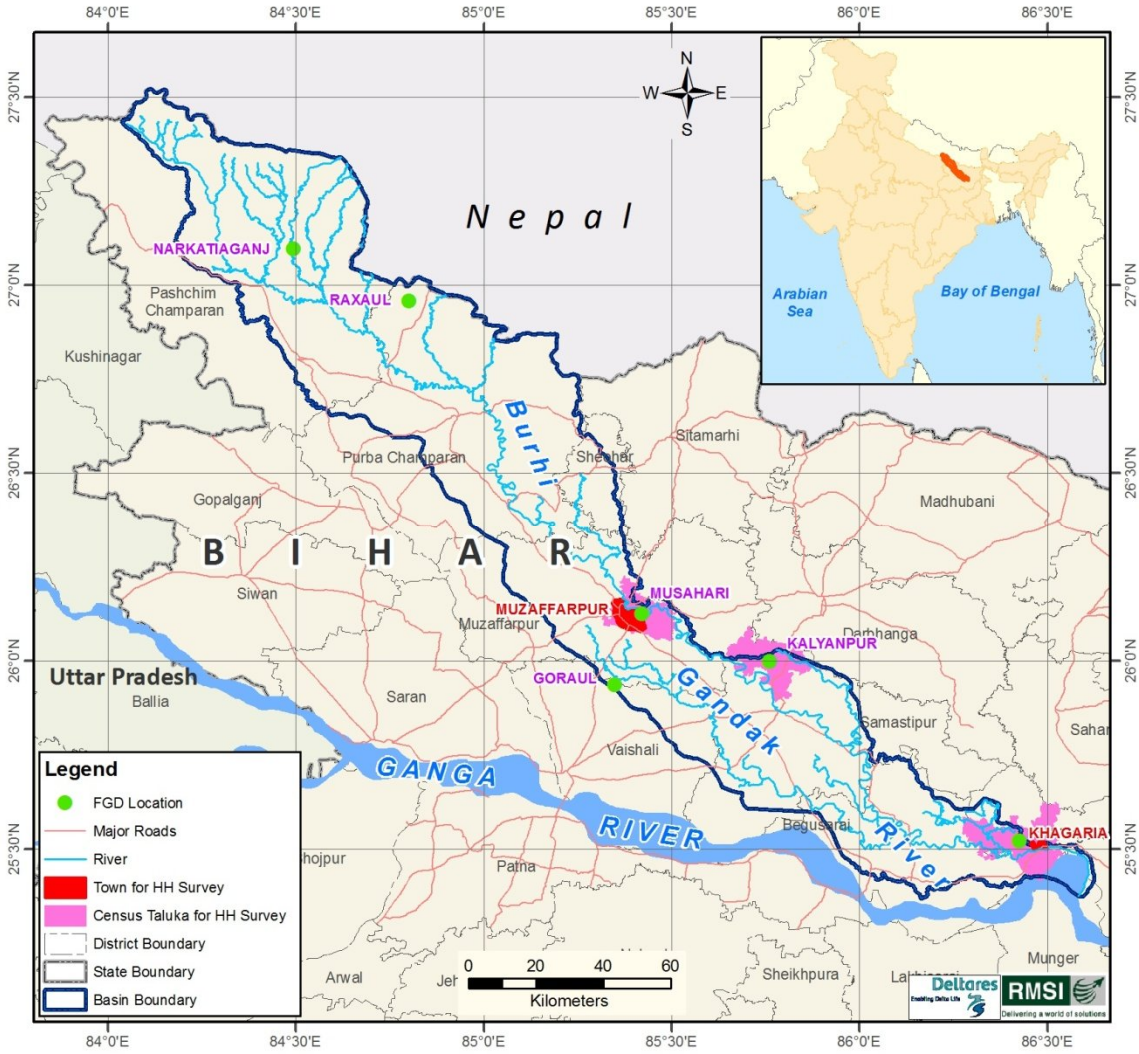


Figure 2-1 FGD and Household survey locations in Burhi-Gandak basins

Chapter 3 Community Profile

3.1 Demographic characteristics

3.1.1 General description

There are 11 districts and 171 talukas in the basin with a total population of 35.6 million which is 34 % of the Bihar state population.

The study area mainly constitutes of rural population with 6 municipalities, which are district headquarters and 14 notified area councils.

3.1.2 Population profile

The population density is 1,316 person/sq km while considering the districts in the basin against the state population density of 1,106 person/sq km. The Pashchim Champaran district has the lowest density of 753 person/sq km and Sheohar district has the highest density of 1,880 person/sq km. The Sheohar district is having the highest density in the state. The Figure 3-1 shows the population density distribution in the basin as per Census 2011. It should the population distribution is pretty homogenous rather than concentrated in one part – up, mid or downstream of the basin. The sex ratio is 901 female for 1000 male population, while the state average is more favourable to female; 918 female to 1000 male.

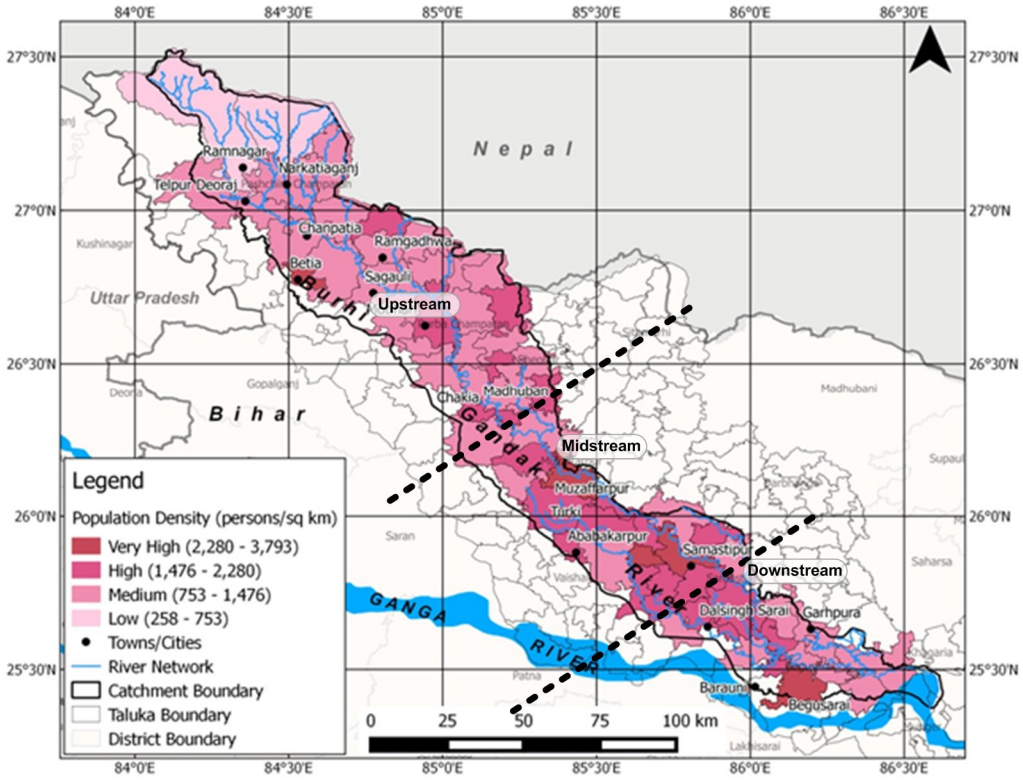


Figure 3-1: Taluka-level population density distribution in BG basin, Bihar

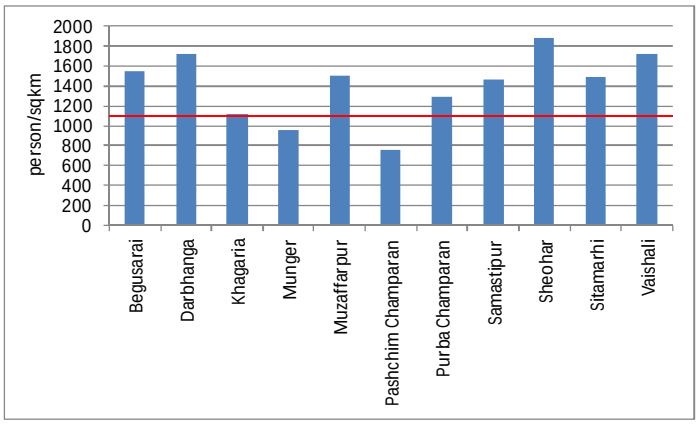


Figure 3-2: Population density at taluka level, BB basin, Bihar (Census 2011)

As per the Census 2011, the Schedule Caste (SC) and Schedule Tribe (ST) population together constitutes 16 % of total population of the BG basin. Bihar is one of the bottom 5 states with ST population. In the sample, the SC and ST household constitute 23 and 2% respectively. As per the survey, the majority of the rural and urban population is general category with midstream having more SC population. In general, the SC and ST population is part of the economically weaker communities. The caste composition of the household survey is provided in Figure 3-3.

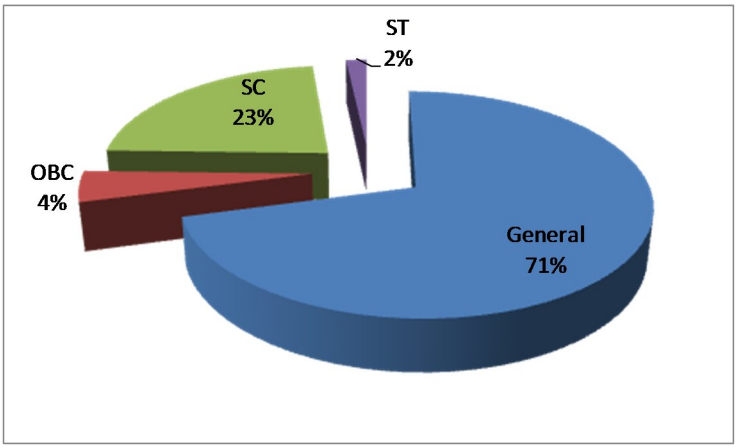


Figure 3-3: Caste composition of population, BG basin as per household survey

3.1.3 Education profile

Education is one of the important elements for communities to access information related to disasters, early warnings, access relief-related information, etc. Literacy in Bihar is not in par with many other states in the country. However, during the past decade the literacy rate has witnessed an increase from 47% to 61.8% (census 1991, 2011). The literacy rate of the talukas in the BG basin as per Census 2011 is 48%, which is lower compared to the State average of 61.8%. The household survey shows literacy rate of 46% (Figure 3-4).

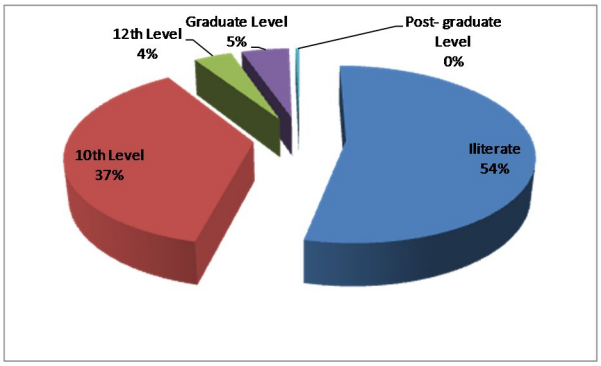


Figure 3-4: Education composition of the household as per household survey

As per the sample survey, there is no drastic difference in the literacy between midstream and downstream and also between rural and urban areas. Only difference is that urban population has slightly higher number of people with higher degree – graduates and post graduates. This is due to better educational facilities available in the urban areas.

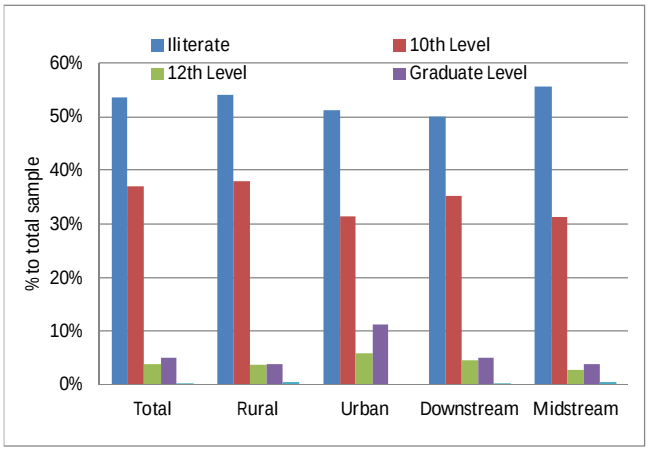


Figure 3-5: Education composition of the household by location as per household survey

Illiteracy rates are higher among ST followed by SC population. The general category people tend to have better education as per the sample survey.

The basin has a very poor density of schools (23,715) while comparing the number of student per school which is 436 students per school as per the Census 2011.

3.2 Household characteristics

3.2.1 General description

The average household size is 5.5 persons per household. Sheohar district has the lowest household size of 4.4 and Vaishali has the highest, which is 5.6 persons per household. The sample survey shows higher figures of 8.6 persons per household. The rural household show a higher family size of 8.8 persons per household compared to urban household size of 7.9. The household size of ST is the highest which is almost 10 members per household.

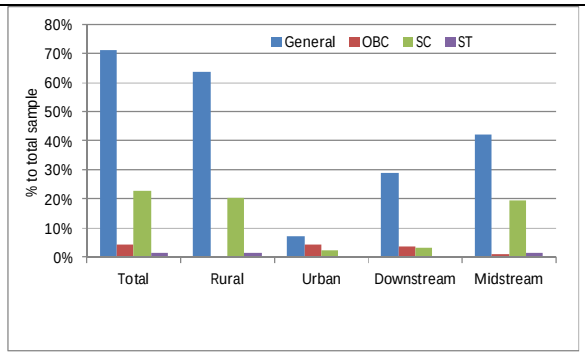


Figure 3-6: Population composition, BG basin as per household survey

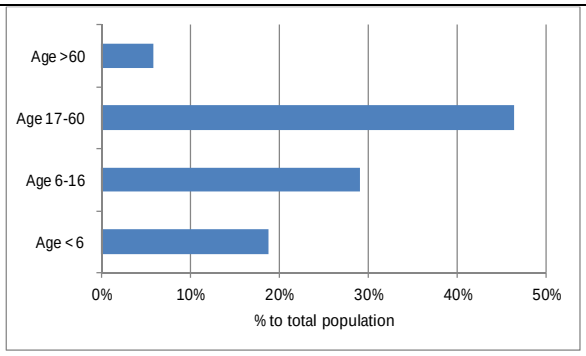


Figure 3-7: Age structure, BG basin, Odisha as per Census 2011

As per Census 2011, the age structure shows population of age <6 and >60 together constitute 25%, while population between age 6-16 constitute 29%. This means, the potential income earning population constitutes 46% of total population. The sample survey data shows there is a substantial number of differently abled/ chronically diseased people (about 16%).

3.2.2 House type

In general, across the country there is a distinct difference in house type composition among rural and urban area and this holds true for Bihar State as well. It is important to understand the house type composition, as the vulnerability to flood varies with house types. The house type is also an indicator of the economic well-being of the community. The rural areas of the BG basin are also characterized by more kutcha houses and fewer number of pucca houses. The distribution of houses as per our survey is presented in Figure 3-8, which shows 50% of the houses are kutcha houses and rest are almost equally shared by semi pucca and pucca houses. In the case of urban areas, this scenario is reversed with more pucca and semi pucca houses with exceptions in slum pockets which are mostly kutcha houses.

The houses are classified into kutcha, semi pucca and pucca house-types, based on the roof, wall and floor materials. Kutcha houses are mostly huts and are made or straw, grass, plastic and wood. The semi pucca houses have tile/tin/asbestos as roof material, burnt brick, mud or mud brick covered with cement materials for walls, and cement for floor material. Pucca houses are concrete houses with roof made of concrete, walls with bricks and cement, and floor cement/tiles/marble (Figure 3-9, Figure 3-10 and Figure 3-11).

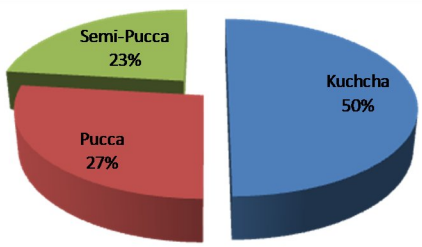


Figure 3-8: Composition of house types in the BG basin as per household survey

Figure 3-9: Kutcha house

Figure 3-10: Semi-pucca house

Figure 3-11: Pucca house

3.2.3 Income and sources of income

The primary income source of the community is agriculture related activities. The urban population depends mainly on the service sector. The income composition shows about 25% of the sample are earn INR <3,000 and almost 30% each are in the income groups of INR 3,000-5,000 and INR 5,000 to 10,000 per month. It may be noted that about 3 months of the year most of the people working in agricultural sector won't have income as there won't be much job during rainy months. This means the average annual income is slightly lower that what is mentioned above.

Majority of the households in the sample depend on causal job for livelihood which is related to agriculture. Farmers are engaged in subsistence farming (for own consumption) and some for generating income as well. The composition of sources of income as per the survey is provided in Figure 3-12. Farmers in the basin mostly grow single crop in a year. A handful of farmers are generating income through sale of crop.

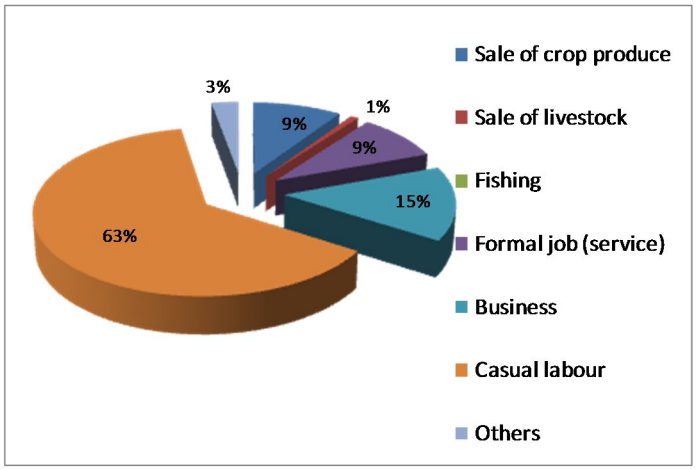


Figure 3-12: Income source of the community as per household survey

It is interesting to note that substantial percentage of the sample household living in kutcha houses reported to have a monthly income INR 3,000-5,000 and INR 5,000-10,000 per month. The income verses house type information is provided in Figure 3-13.

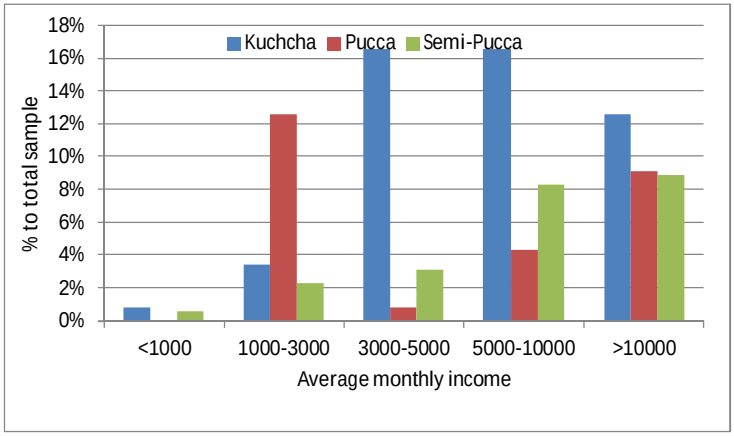


Figure 3-13: Income and house type as per household survey

The income composition among social groups (caste) – general category and other communities, does not show much disparity. The higher income groups are mostly general category and SC and ST community are mostly in the lower income.

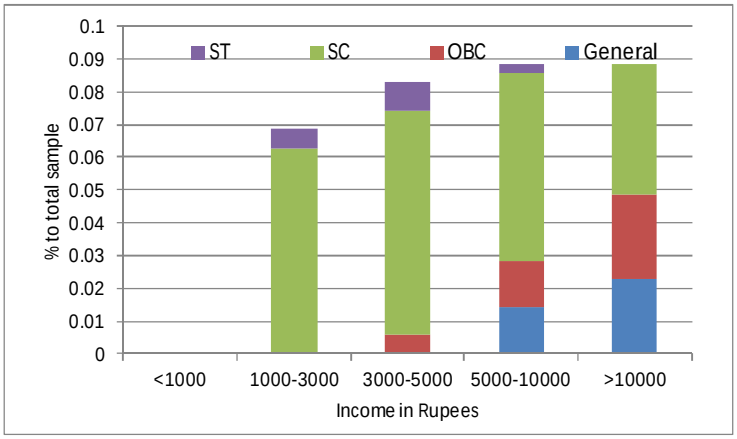


Figure 3-14: Income distribution among various social groups

3.2.4 Household assets

Household amenities reflect the economic affluence of the community. Comparison of household assets shows that general category community has better assets compared to SC and ST households. The income distribution also shows similar trends. About 23% of the households only has TV and are mostly with the higher income group. Almost all the households have cell phones and many houses have more than one cell phone. About 70% of the households have radio and only 13% of the houses has electricity.

Community keeps a few livestock at home as reserved asset and sell when they are in need of extra money. Cattle, goats and buffaloes constitute the major share. Economically poor people keep goats which is cheaper to buy while relatively better of people will have cow and buffaloes. The Figure 3-15 shows the composition of livestock and poultry in the sample household surveyed.

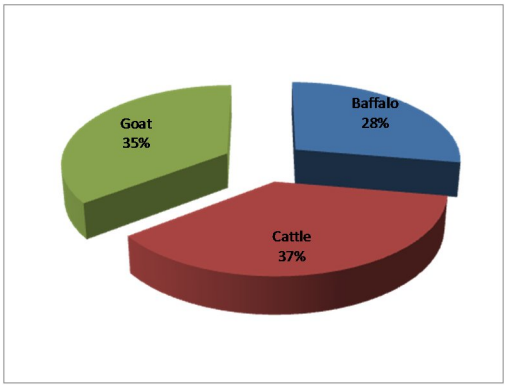


Figure 3-15: Livestock and poultry compositions as per household survey

3.2.5 Location of house

As mentioned in Volume 1 and 2 reports, BG river is a jacketed river with embankments almost all along the river. The population density in the basin is more or less uniform and is relatively higher compared to other parts of the state.

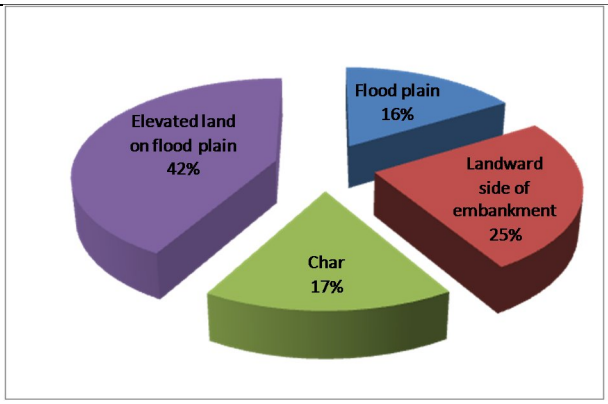


Figure 3-16: Distribution of houses in the BG basin as per household survey

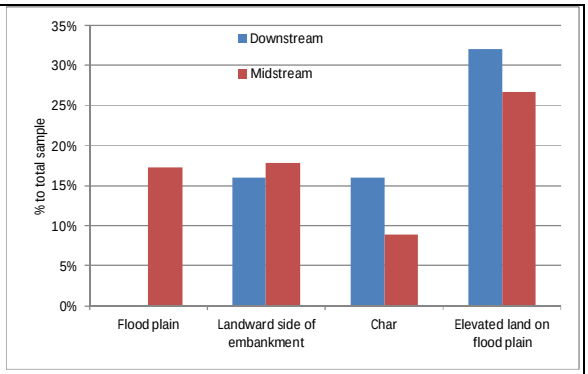


Figure 3-17: Difference in the distribution of houses in mid stream and downstream, BG basin as per household survey

The survey shows that 33% of the sample houses are on flood plain and newly formed land on the bank of the river ("*Char*") and rest are protected either by embankment or on elevated land.

The mid and downstream side of the river has a large number of houses on the floodplain and *Char* developed compared to upstream. There is a significant population living within the embankment. However, the houses on the landward side of the embankments are not protected due to the braided nature of the rivers.

Figure 3-18 shows satellite imagery showing settlement (including pucca houses) and other structures on the river side of the embankment in Muzaffarpur district.

Figure 3-18: Pucca houses on the river side of the embankments (green circled area), Muzaffarpur, BG, Odisha

The Figure 3-19 shows the location of houses in relation to income. It is interesting to note that majority of the higher income households are on the protected side of the embankments or inland. But there is significant number of high income households living in the flood prone areas – flood plain and on the river side of the embankment. However, social group and location of house don't have any relationship which contradicts the general notion that backward communities, SC and ST are mostly economically weaker.

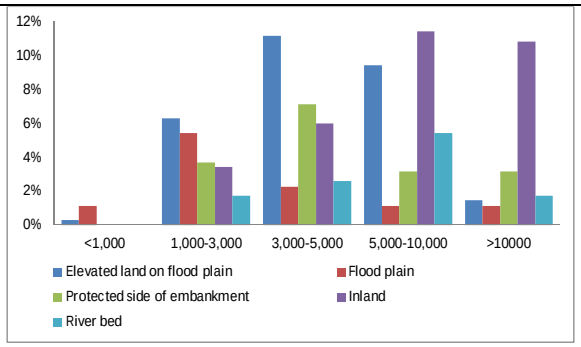


Figure 3-19: Income vis a vis location of house as per household survey

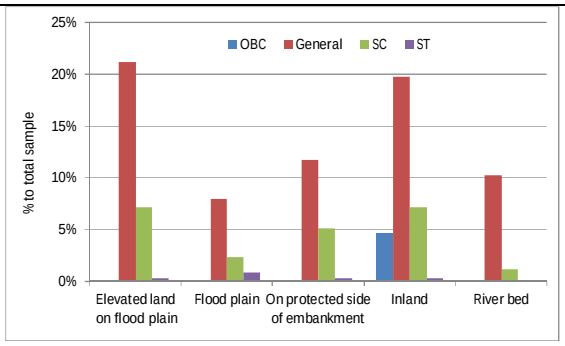


Figure 3-20: Location of houses by social group (caste) as per household survey

3.3 Access to public facilities

As per census 2011, only 13% of the households have electricity connections and about 90% of the household are using hand pumps for drinking water. The State has constructed elevated platforms with drinking water facilities in most of the flood affected district. However, during the FGDs, villagers raise their concern of poor access to shelter during flood season. The incidence of water borne and vector borne diseases is very high in the state. The FDG and survey results also capture this as a key problem and are presented in sub section 4.4.

The state has very poor toilet coverage. As per census 2011 Bihar is one among the 5 states (Odisha, Bihar, Madhya Pradesh, Chhatisgrah, Jharkhand) which has no latrine facilities within house premises. As per the household survey, 66% don't have proper toilet facilities with more houses percentage in rural areas.

3.3.1 Access to road

As per the household survey, majority of the households responded that they have access to all weather road (88% household with <1 km). One of the key reasons for this is that roads were constructed on top of the embankments. However, there is poor road access to agriculture land. There are black top roads and permanent structures on the river side of the embankments.

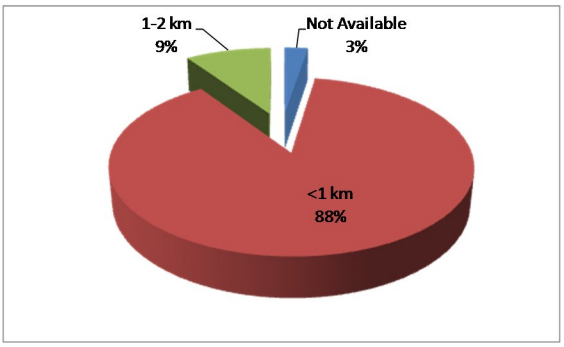


Figure 3-21: Household access to all weather roads as per household survey

3.3.2 Access to public health facilities

As per the census 2011, there are 9,639 hospitals, which include village level basic health facilities like Public Health Centres (PHC), Community Health Centre (CHC), and referral hospitals in the basin. This also includes private hospitals and clinics. This means that there is one hospital/health facility per 3,695 people.

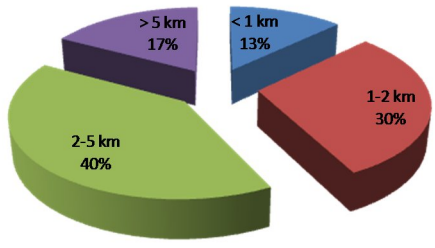


Figure 3-22 Distance from your home to nearest health post (in km) as per household survey

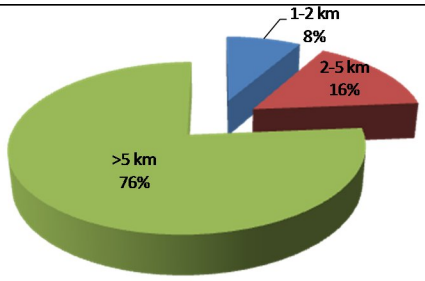


Figure 3-23 Distance from your home to nearest (referral) hospital as per household survey

Only 13% of the respondent told that the nearest health post of any health support in < 1 km, while majority 40% responded that the nearest health post or clinic for them is 2-5 km away.

As per the household survey, majority of the households (76%) has responded that they have to travel more than 5 km for referral hospitals. Only 8% of the respondent mostly urban respondent has better access to health facilities.

Chapter 4 Problems and Issues in the Community

4.1 Flood hazard characteristics

Floods occur in BG basin is mainly due to heavy monsoon rain. The Table 4-1 shows the historical flood statistics in the districts of BG basin. Most of the floods occur during the months of July to September with casualty of human life and loss of agriculture and assets. In addition to this, there are damages to public utilities as well. The intensity and frequency of flood in the basin has reduced since 2007. This is also reflecting in the loss statistics as well as during the field consultations.

Table 4-1: Flood loss statistics, district in BG basin (1991-2012)

Years	People affected (million)	Affected land (lac ha)	Estimated crop damaged (INR Lac)	Estimated house damaged (numbers)	Estimated public property damaged (INR Lac)	Casualties (numbers)
1991	6.88	1.88	642.40	193.91	27.70	16.00
1992	0.34	0.09	2.00	9.00	-	-
1993	18.88	3.12	7,293.80	1,982.59	72.76	21.00
1994	15.33	1.93	2,567.32	290.57	2,046.05	20.00
1995	7.35	1.26	738.82	160.85	58.01	28.00
1996	17.67	2.39	3,062.98	202.09	16.50	50.00
1997	NA	NA	NA	129.00	1.45	25.00
1998	35.66	8.90	12,267.14	1,859.35	1,090.43	60.00
1999	15.01	2.14	9,409.34	190.94	91.00	46.00
2000	11.44	1.95	1,488.13	79.87	129.56	41.00
2001	31.09	3.31	10,139.12			
2002	35.98	4.37	16,306.16	4,054.22	9,116.63	
2003	21.88	5.44	4,372.01	1,296.41		97.00
2004	60.67	7.46	24,616.40	23,614.78		316.00
2005	9.20	2.96	370.98	60.43		20.00
2006		7.15	818.28	1,480.76	7,456.17	14.00
2007	NA	NA	NA	NA	NA	NA
2008	3.60	0.14	336.94	799.85	80.03	18.00
2009	4.88	0.64	1,151.55	21.00	55.00	22.00

2010	4.47	0.70	115.50	152.85	100.00	5.00
2011	2.84	15.25	435.51	50.92		42.00
2012	1.20	0.27	135.80	0.60	141.00	9.00

Note: NA data not available

Source: District Disaster Management Authority, Bihar

There is large number of people living on the river sider of the embankment in pucca houses and on newly built river banks locally known as "*Char*". It is mostly kutcha houses built on "*Char*".

4.1.1 Occurrence of flood

The flood loss statistics (Table 4-1 and Figure 4-1) shows that the loss due to flood in the basin has reduced drastically after 2004. During the FGD also community in most of the villages mentioned the last flood as 2004 flood and few mentioned 2007 flood.

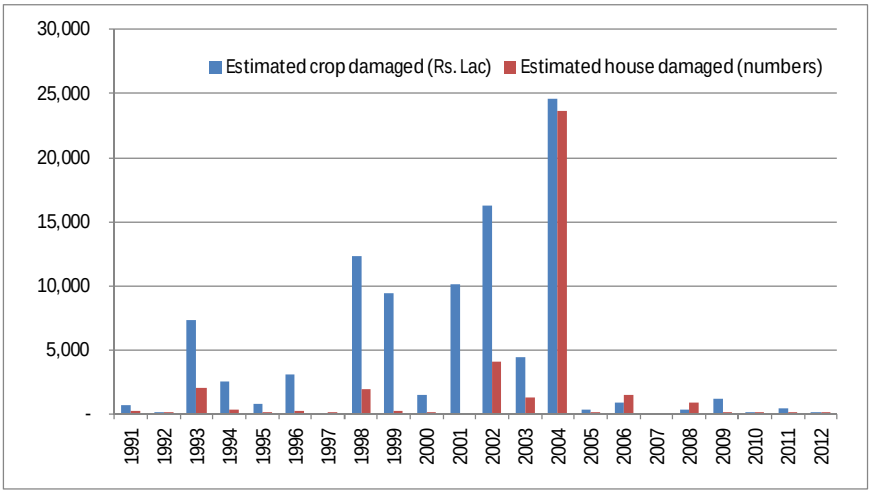


Figure 4-1: Loss of crops and houses in BG basin (1991-2012) as per Census 2011

Based on responses from household survey FGD, it is understood that the flood events of 1987, 2002, 2004, and 2007 were severe and has affected many villages of the basin (maximum responses).

The state statistics shows the 2007 flood was the recent flood which cause widespread damage and loss in the state. It has affected 17 out of 36 districts killing more than 500 people and damaging extensive agricultural lands. The 2007 flood situation continued for more than 2 months, severely affecting about 69 lakh people. The worst affected districts were Muzaffarpur, Sitamarhi, Saharsa, East Champaran, Darbhanga, Patna, Supaul, Bhagalpur, West Champaran, Katihar, Madhubani, Samastipur, Sheohar and Nalanda. Multiple embankment breaches (at 32 points) in many rivers caused major havoc across the state.

In general, the nature of flood in BG basin upstream is more flashflood as water comes from Nepal, while the mid and downstream is slow process. The tailend of the BG in Khagaria district and neighbouring region has the backwater effect of adjacent rivers like Ganga.

4.1.2 Flood event duration and characteristics

As per the household survey, the mid stream reported more events (67% of the reported events) compared to downstream. The responses from two urban areas (Muzaffarpur and Khagaria) surveyed didn't report any floods. There are some pockets of Muzaffarpur town experiencing water logging problem due to poor storm water system in the old town. The existing urban channels are encroached and choked with urban solid waste increasing the susceptibility of urban flood.

The duration of flood reported in the basin is long, mostly more than 10 days. While comparing the midstream and downstream, downstream has longer duration of standing flood.

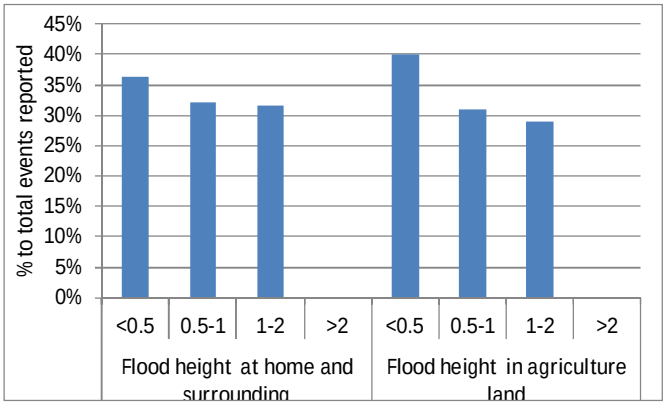


Figure 4-2: Flood height in settlement and agricultural fields as per household survey

The Figure 4-2 shows the responses of households surveyed on flood height at home and in their agricultural fields. Majority of the responses show the flood height is 0.5m in home and surrounding area and in agricultural fields. However, 30% of the respondents reported flood height of 1-2 m. The duration of standing flood water is reported to be 10 days. The standing flood water damage both crops as well as affect the health of livestock.

As mentioned earlier, the BG river has embankment all along the river. As per the household survey, the cause of flood is more due to overflow of embankment (52% of the respondents), however, there are some cases of people deliberately breaking the embankment to protect villages upstream. However, natural breach is also a major cause of flooding accounts to 10% of the response.

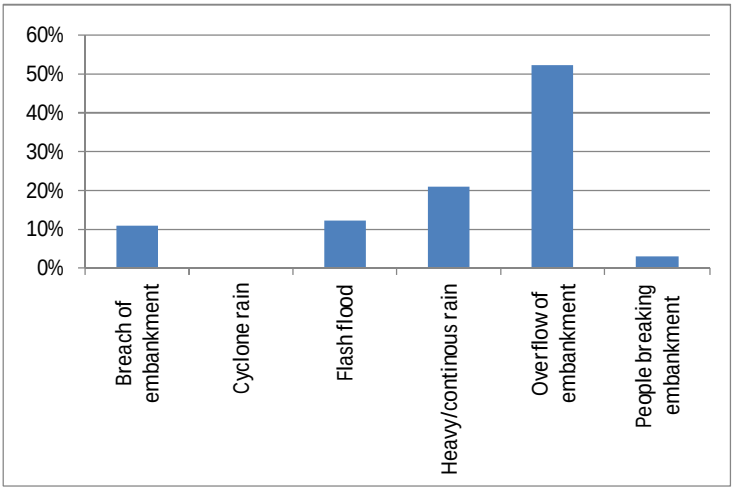


Figure 4-3: Causes of flood as per household survey

4.2 Environmental problems

Water logging is reported to be the most serious and widespread problem in the basin. Water logging is extensive in the midstream (Muzaffarpur, Samstipur district) of the basin while the problem persists in the downstream as well. The upstream area experiences water scarcity during the non-rainy season. The community also pointed out that constructions of roads especially the Darbhanga-Samastipur road (between Kalyanpur to Jatmalpur) has affected the free flow of water causing extensive water logging problem in the region.

Sedimentation in the river channel and low lying agricultural land is high in the basin which leads to water logging conditions. During the survey, community informed that flood from Gandak bring sand which is not good for the agricultural land while the flood from Bagmati bring in silt which is more fertile. Heavy siltation on the river and irrigation channel makes the irrigation not possible. During the FGD it is captured that Damodarpur canal and Turhut Main Canal (Gandak Project) are abandon for years as they got silted up. About 10% of the households informed that they face problem of heavy sand deposition on the agricultural lands.

The meandering nature of the river in the mid and downstream deposit silt on the leeward side while carves the agricultural land on the curved side leading to loss of agriculture land. Farmers either moves back to accommodate the river or move to the other side of the river to cultivate in the newly formed land.

Groundwater table is shallow and has a high potential to use as source for irrigation in the floodplains during the non-rainy season. This is not being used to the optimum potential which is also making the groundwater saturated leading to less absorption during the flood season.

4.3 Houses and household assets damaged

4.3.1 Household assets

The household asset, public infrastructure and agricultural crops get damaged due to flood in the BG basin. In terms of damage as per the Table 4-1 the damage was severe in 1998 and 2004. Almost 80% of the respondent report that they have lost house or household asset due to flood in one or other event during the last 20 years.

4.3.2 Agricultural assets

Agriculture is the main livelihood for the community with Kharif as the main crops. The flood mostly hit Bihar during the Kharif season which is very damaging. Mostly the damage is for rice and maize. Long standing water also affects perennial crops like litchi and mango.

The agricultural losses reported during the last 20 years mainly include rice (80% of the response) and 14% lost maize crop. Khagaria is one of the Asia's largest producers of maize which is on the tail end of the BG basin.

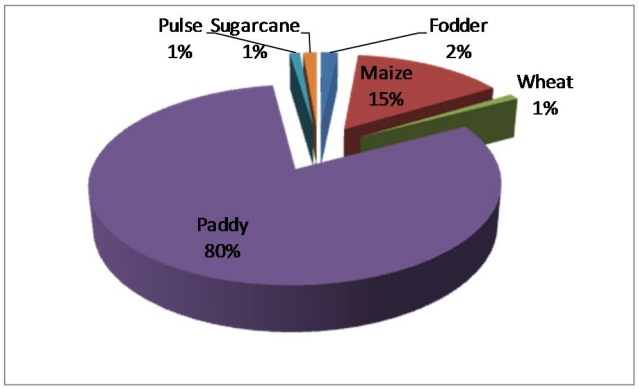


Figure 4-4: Composition of agriculture assets reported as per household survey

The death of livestock due to flood has almost equal composition of buffalo, cow and goat. The buffalos are more sturdy animal and can withstand flood condition compared to cow and goats. Households don't have poultry at home and for that reason casualty of poultry is not reported much.

4.3.3 People affected

Only a narrow stretch of the basin gets affected by flood and particularly people living on the river side of the embankment. Heavy flood from Nepal cause flash flood situation on the upstream – East and West Champaran districts. People across the social group are affected due to flood as all social groups are living on the river side of the embankment. Economically less privileged people chose to live on the river side of the embankment as these land are cheaper.

The flood water in many place reported to stay for more than 25 day and there is lack of adequate flood shelter. Flood isolates villages for months and the access for community is basically using boats. During the FGD, people reported that boat accident during flood months often cause casualties.

Flood shelters are mostly in the form of open elevated platform. Khagaria which is on the downstream joint of Gangas and BG river basin is highly vulnerable to flood from Gangas and BG rivers. People in Khagaria move to national highway, Khagaria bazar (market) or terrace of paccu houses.

4.4 Flood related health issues

As the duration of flood in this basin is longer (in some place upto 25 days and even more) cause serious health problems. The state has digged several tube wells with hand pumps on the embankment to ensure safe drinking water during monsoon season. However, the incidence of waterborne and vector borne diseases are high in the basin during and after monsoon season or any flood situation.

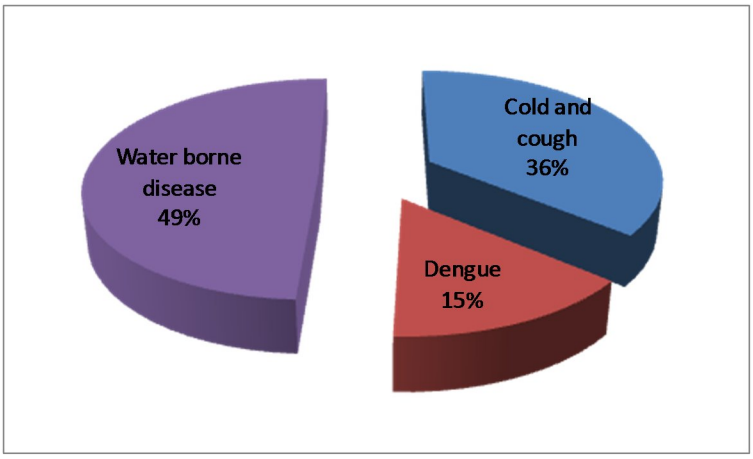


Figure 4-5: Reported incidence of major diseases during flood period as per household survey

The Figure 4-5 shows there is a higher incidence of water borne diseases during the flood period. We have only consider responses of last 10 years as people's memory on disease events in the family (unless major event) were likely to be forgotten over time. There are several household with more than one case of dengue and water borne in the same flood time

The disease incidence is higher in rural area compared to urban and also in the midstream than downstream. As mentioned earlier the midstream region has severe water logging problem which can be the reason for the higher incidence of water borne diseases.

The poor access to health facilities also accentuates the problem. During the rainy season and floods, many villages are affected by poor road access.

4.5 Perception towards flood

The occurrence of flood in the basin often but the frequency has reduced during the last 10-15 years. The frequency of flood in the basin has reduced and this is causing more damage as the communities during flood events as they are not prepared. The community in the downstream, who are frequently affected by flood, prepare themselves every year. According to them, the water from Bagmati stop coming into BG 10-15 years and has reduced the frequency of flood in the basin.

Traditionally, community stocks processed and sun dried cereal foods for rainy season, which can be eaten without cooking. They also stock fodder for the livestock and firewood for the kitchen. However, during interactions with the community, it emerged that they often ran out of stock during floods, particularly drinking water and fodder. Some of the traditional foods stocked by the community in this region include *Chuda* (beaten rice), and *Sattu* (roasted Channa and made into powder which can be mixed with water/milk and drink).

During the community consultation, people (particularly in the downstream) explained that they experience flood so often and they are not fear of flood. They are more fear of their household assets being stolen and so during flood time they sit on top of the roof of their house or neighbours house to safeguard their household assets from stealing. People conveyed that they use to observe the river water level for understanding flood situation rather than wait for EWS.

The State with the support of UNDP has prepared village level disaster management plans and formulated DM committees at village level for all the villages of the State in 2007. However, these

DM committees are not active in all most all the villages soon after the completion of the project. While enquiring about the preparedness almost all responded that they prepare themselves to protect their family from flood.

There is no flood safety mock drill or any such exercise from state side as part of community awareness. Villages where NGOs or CBOs involved in community based activities support the communities to form DM committee and provide training to carry out various preparedness activities before the rainy season starts.

The level of literacy rate probably is one of the key reasons of low level of awareness of flood preparedness and community's poor enthusiasm towards coordinating together for flood management activities. However, it should be noted that in Bihar, there is the history of community voluntarily contributing to construct flood protection structures. In 1954, during the embankment construction in Kosi river, community has contributed voluntarily their effort in the construction activities. It needs community mobilization to encourage community to involve in the flood protection and mitigation activities rather than encroaching embankment for construction of permanent housing structures.

Traditionally, community observe rising level of water in the river to monitoring flood levels and take necessary steps to protect live and asset to the possible extend. However, many of the community knowingly carry out agriculture activities in the flood plain giving livelihood more priority than risk.

4.5.1 Vulnerability assessment

The communities in mid and downstream of the basin are vulnerable to flood hazard. As mentioned earlier the frequency has of flood events has reduced. Probably for that reason there are large number of people living on the river side of the embankment in permanent structures (Figure 3-18). Lower, middle and even a good number of high income people are living on the river side of the embankment. The Figure 4-6 shows the location of houses versa verse income group. It can be noticed that people are constructing houses in the newly formed land locally known as "*Char*".

The choice of selecting the location for living determine the vulnerability levels. However, poor people in the hazard prone area tend to construct kutcha houses due to economic constrains and are thus more vulnerable to flood.

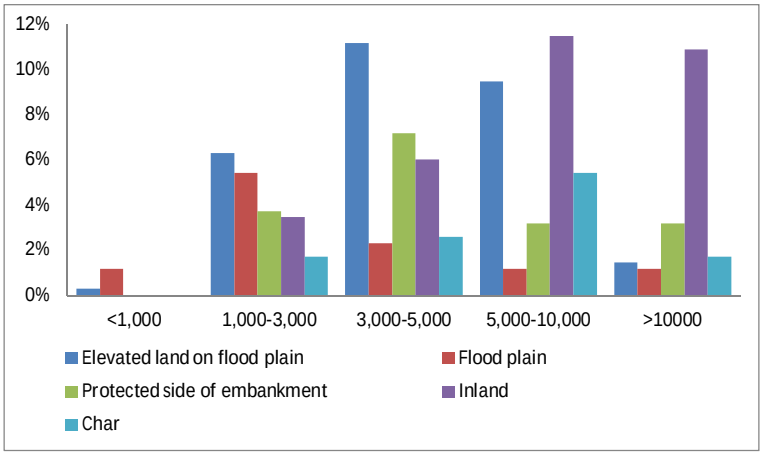


Figure 4-6: People living in different location versus income

During the household survey we also try to understand the community's level of awareness about their own vulnerability. Majority, almost all the rural respondents told that their family is vulnerable to flood and that too they consider it as highly vulnerable (Figure 4-7).

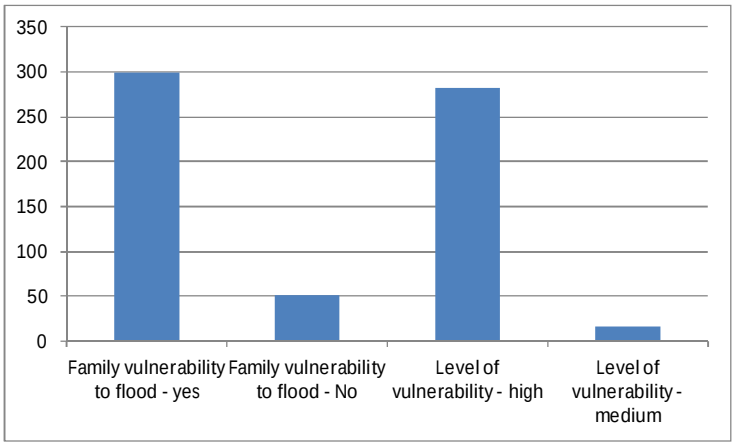


Figure 4-7: Level of vulnerability self assessed as per household survey

The coping capacity of community is poor in general and particularly for the poor people. The Figure 4-8 shows the responses of household in terms of availing weather advisories, community and household level preparedness.

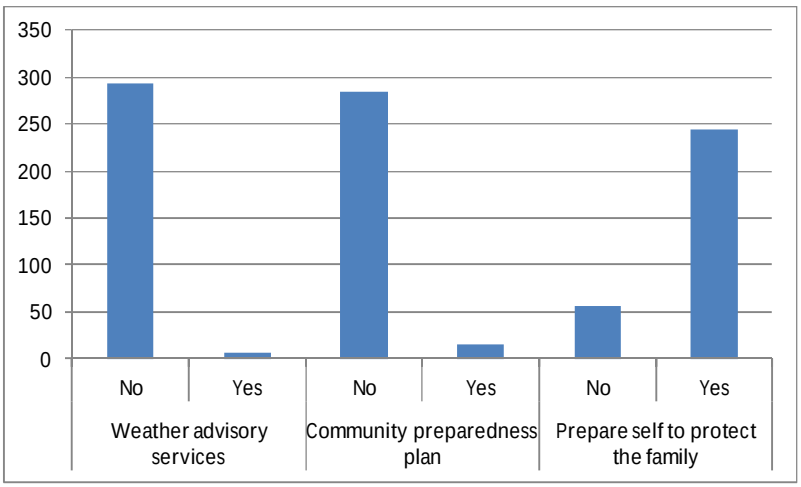


Figure 4-8: Coping capacity as per household survey

It is interesting to note that the community is not getting weather advisories and don't have much community level preparedness. Community take whatever possible preparedness they can take at their own level to protect the family.

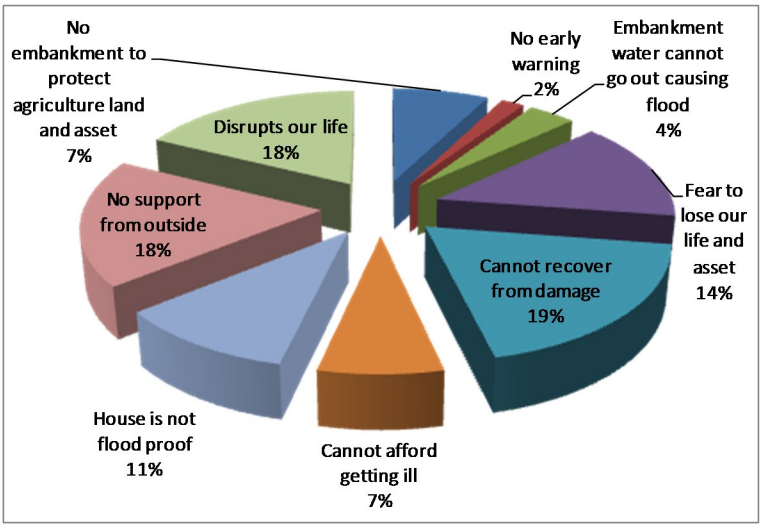


Figure 4-9: Reasons of vulnerability as per household survey

The key reason of vulnerability as per the household survey is Figure 4-9 which shows several issues. However, the bottom line is livelihood and protection of house and household asset are the key concerns of the community.

Chapter 5 Flood Management in the Community

5.1 Evaluation of flood preparedness measures

Community is aware of the floods and associated risks. People are living in the flood zones. However, as mentioned in the above section and in Figure 4-8, the level preparedness is very poor and community start dealing this problem at household level.

The reduction in the frequency of flood reduces the level of community preparedness. Flood coming unexpected is more damaging than regular one. Traditionally, community practices stocking various processed rice and cereal products, which can be eaten without cooking.

There is no much flood preparedness initiatives by the State, or other authorities. There are not much NGOs or CBOs working in the DM activities in the basin. There are couple of NGOs working in poverty reduction but not much involvement in flood preparedness/management.

5.2 Status of flood preparedness in the community

As mentioned in section 4.5.1, the community level preparedness of people living in the basin is poor. Basically, family takes their own way for measure to protect to the family from flood to the possible extent.

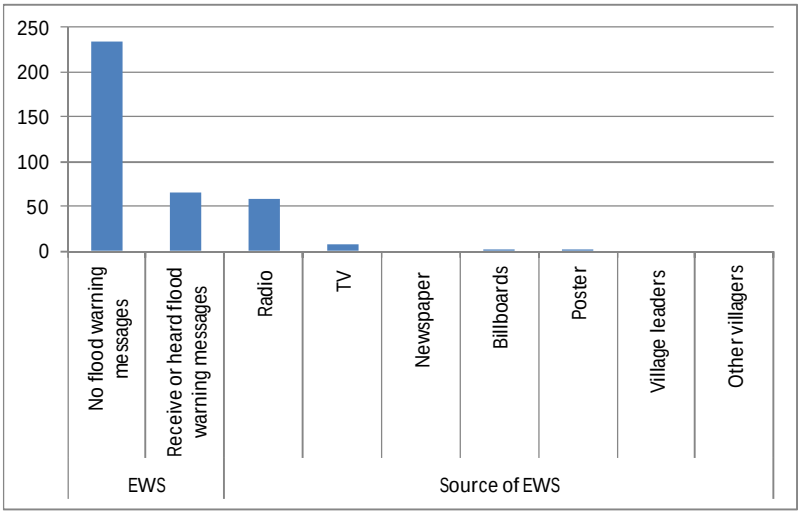


Figure 5-1: EWS and their source as per household survey

The poor people don't have the economic capability or rather they prioritise their economic needs to basic living needs (food) than flood proofing of their houses like increasing plinth height of their houses.

While analysing the plinth height of houses against the location of houses, it was observed that a majority of the houses are at ground level or < 1 m height (Figure 5-2).

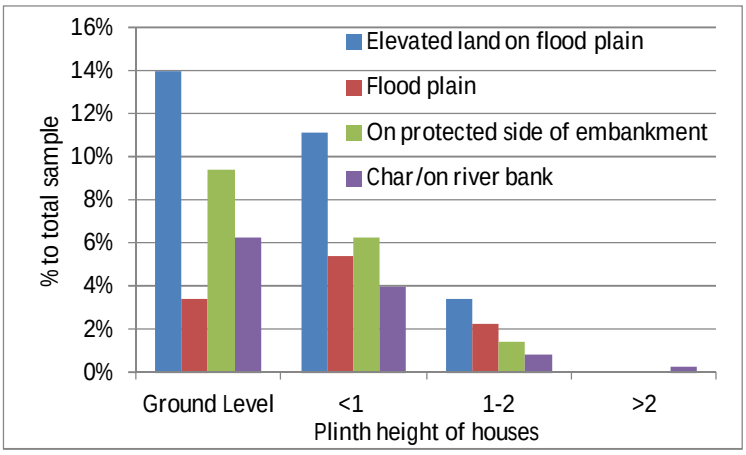


Figure 5-2: Plinth heights of houses at various locations as per the household survey

The state often distributed flood tolerance varieties of rice seeds but there is less preference among farmers as its yield is inferior to hybrid varieties. Communities tend to gamble with the flood/drought hazard than opting for flood and drought tolerant rice varieties due to the yield factor.

Majority of the respondents (67%) informed that they never get any warning information related to flood. Rest of them responded that they receive warning information through radio, local billboard and newspapers.

As there is no adequate shelter facilities, community often resort to embankments, terrace of pucca houses, schools and elevated roads.

5.3 Measures recommended

It needs intervention at sub district particularly at village level to strengthen the level of preparedness of the community and also for community to involve in some of the flood management activities. There should be a mechanism to develop ownership on community to maintain the embankment which will develop ownership and avoid breaking it during floods.

As the basin has embankment all along the river and breaching and overflow are two key causes of flooding it needs measure including proper maintenance and surveillance of embankment, elevate the height of the embankment based on scientific calculation of probability of flooding.

It needs intervention at State level, and at community level for maintenance and surveillance of embankment and to improve the level of preparedness of the communities. The urban areas in the basin are fast developing and are expected to have a different level of problem of urban flooding due to inadequate storm water system and choking/encroaching of the channels in the urban areas. It needs proper planning for designing urban drainage and also enforcement of landuse and development regulations to avoid urban flooding.

5.3.1 Institutional level

- It needs capacity building of local administration for providing extension work and work with the community on DM particularly on flood management.

- Local administration should coordinate with state agencies for developing and providing weather and climate linked agro-advisory services to disseminate such information to communities, so that they can plan their farming practices.
- Agriculture extension workers should regularly visit the rural villages and provide training on new technologies and modern agricultural practices including advisory support on suitable crops based on local conditions. Demonstration plots are best means to promote new crops and adaptation practices.
- Agriculture extension service should coordinate with local administration and local communities for developing drainage channels in water logged areas.
- Promote and provide access to sturdy crop varieties - drought and flood resistant crop varieties and demonstrate their benefits through demonstration plots.
- Construct additional shelters with drinking water and sanitation facilities in the flood prone areas
- Construct community godowns for safely stocking crop harvest, seeds and fodders
- Introduce incentive mechanism like tax rebate for elevated plinth height, or for adopting other flood proofing constructions.
- Panchayat development planning need to consider DM particularly flood management activities in local planning and development.
- Encourage extraction of ground water for agriculture activities for flood cushioning.

5.3.2 Community level

- Mechanism through enforcement and incentives need to be adopted to encourage communities to follow CWC guidelines of avoiding construction of permanent structure on flood plains and on the river side of the embankment.
- State should promote NGOs and CBOs to involve in community based activities to revive the DM committees and need to carry out the defined roles and responsibilities of each DM task force so that during flood situation they can support the community.
- Community awareness programs are required on safe drinking water and sanitation particularly during flood situation.
- Communities should select appropriate crops and cropping patterns suitable for flood prone area like cultivation of water intensive crops like sugarcane in waterlogging areas.
- Communities should explore the possibilities of group crop insurance against flood/drought hazard.

5.3.3 Urban measures

- The municipalities should consider flood hazard in its urban master plan and identification of development zones should consider the flood hazard zones.
- There should be strict enforcement of building codes and development control regulation. The building codes need to be revisited by technical experts to accommodate climate change impact and flood risk of the region.
- Develop building codes and guidelines and should be available for the public to develop flood resilient housing.

- Development of storm water drainage taking into consideration of the climate change impact.
- Awareness among community not to encroach urban drainage and dumping of solid waste in the urban drainage systems.

5.4 Coping mechanism to protect livelihood

- Follow weather calendar for agricultural activities.
- Adapt cropping pattern and crops to the changing rainfall pattern.
- Choosing climate resilient (flood/drought and salt tolerant) varieties in flood/drought/saline prone area.
- Any introduction of new crops to adapt to the new condition need proper mapping of the supply chain and ensure mechanism that the new farm products generated has adequate market for community to adopt this.
- Avail crop insurance as safety network.

5.5 Participation of community in flood management activities

- Preparedness including reviving of DM committee and local DM plans.
- Stocking of medicine and essential facilities before the onset of rainy season.
- Training of committee in flood management in different stages (preparedness, response, recovery).
- Work with local administration to develop drinking water and sanitation facilities during flood events.
- Training of masons for flood proofing of houses.
- Training of community for identifying and providing first aid for any injuries and diseases that often affect in livestock (foot rot and mastitis) and poultry during and after the flood event.
- Training of communities for channel development in water logged areas.

5.6 Strategies of Community involvement in IFM

It is essential to involve community in developing flood management strategies during prepared, response and recovery to minimize the damage. The Table 5-1 provide strategies for community involvement in IFM activities in various stages.

Table 5-1: Strategy matrix for Community involvement in IFM

Stages of disaster management	Involvement type	Activities specific to the BB basin
Planning and implementation of mitigation measures	Consultation to understand the needs and problems of the community and develop strategies that address the needs and problems	Structural interventions to regulate river discharge Channel improvement to avoid water logging problems Identify and promote suitable alternate livelihood options in the flood prone areas Improve early warning dissemination Awareness and sensitization
	Capacity building and training of local administration	Capacity building and training of local administration to leverage Panchayat Raj Act (73rd constitutional amendment) to mainstreaming DM activities in local level planning
	Agricultural insurance	Promote agricultural insurance through government, cooperative or through agri-business firms as safety net.
Preparedness	Develop local DM plan and committees	Engage Non-Governmental Organizations (NGOs) and Community Based Organizations (CBOs) to work with communities to revive the DM committees and keep them active for preparedness, response and recovery
	Local level landuse planning	Involve communities in development local landuse plan including flood zoning and encourage communities to adhere to this.
Response	Mock drill and awareness development	Conduct mock drill on flood risk management Develop awareness on dos and don't during flood and post flood. Public announcement system, and display of evacuation route and shelter locations in public places.
Recovery	Training in rescue and recovery	Develop DM task force as part of the DM committee and train them for rescue and recovery operations.

Chapter 6 Conclusion and Suggestions

While structural measures are required for long term flood mitigation, communities need to develop livelihood adaptation strategies and coping mechanism to reduce the risk towards flood hazard. The needs and issues of community vary from basin to basin and even in different morphological stretched of the basin and flood management need to take this into consideration.

When defining adaptation strategies and coping mechanisms, key elements that need to be kept in mind are mentioned below:

- The intervention should be acceptable to the community and not totally alien to the system for ease of adoption;
- Introduction of alternate livelihoods or crops needs market analysis and ensure mapping of the whole supply chain;
- Any introduction of technology for developing adaptation or coping mechanism should not depend too much on external skills as this will be a threat for the sustainability;
- Identification of locally tested indigenous options for adaptation and coping mechanisms;
- Should have net benefits independent of any hazard. Some adaptation options may yield net benefits even without occurrences of any hazard and that need to be encouraged;
- Analyse the barriers for implementing strategies and work effectively to address the same.

Following are the key summary points based on the analysis of the community survey and consultations.

- The frequency of flood hazard has reduced in the basin during the last 10-15 years. The flood affect livelihood (particularly agricultural crops). The casualty of human and livestock is showing a decreasing trend during the last decades which is a good trend.
- The population density in the basin is pretty homogenous and the vulnerability of the community varies with the economics capacity.
- It takes about 25-30 days for flood waters to recede from the agriculture field particularly in the midstream of the basin with some locations experiencing about two months of standing flood water. The houses are mostly in elevated area and are less affected by flood.
- The community needs and problems are distinctly different in the up, mid- and downstream sections of the basin.
- Basin level coordination is required for effective flood management.
- Waterlogging is a key problem both in midstream and downstream of the basin. Upstream of the basin has water scarcity problem as well in addition to flash flood.
- Overflow of flood water over the embankment and breaching are two key causes of flooding.
- Poor maintenance of embankment sluice gates in the canal are also causes problems related flooding and lack of water during non-rainy season.
- Poor sanitation conditions, lack of drinking water, availability of fodder and shelters are the key issues community face during flood season.

- The community preparedness for flood risk management is poor and community tend to prioritise livelihood to risk to flood.

Following are the key suggestions for developing strategies for community involvement in IFM activities:

Planning and implementation of mitigation measures

- As community needs and problems are very specific to river basin. The State WRD and CWC should carryout community need assessment priority to any major intervention projects.
- The State WRD and CWC should make it as a mandatory to conduct community consultations to ensure acceptance of community before finalisation of any project to implement.
- SDMA should prepare and publish flood hazard maps so that community will have a good understanding of the flood risk of area they are living of investing for businesses.

Preparedness

- DDMA needs to take active role at sub district including village level for developing awareness and keep the community level DM committees active.
- State through SDMA and DDMA need to identify and mobilise NGOs and CBOs to involve in sensitizing and mobilising community based activities for flood management.
- State WRD should have proper enforced mechanism for maintenance and surveillance of embankment and O&M of sluice gates in the channels. Provisioning of adequate budget needs to be identified during annual budgeting. Community DM committees should be part of the monitoring and surveillance and should also be engaged for the maintenance activities to ensure ownership.
- The local administration representative should be part of the DM committees and should ensure that these committees meet at least once a month. Local administration needs ensure that these local DM committees are active and follow the defined roles and responsibilities.

Protect livelihood to improve resilience (adaptation measures) specific to BG basin based on existing issues

- State agricultural department should promote flood/drought/salt tolerant varieties of rice to suit to the changed situation of the agricultural land.
- State agricultural department through its extension services should encourage farmers to switch to crops other than rice including short duration cash crops in the flood prone areas to protect their livelihood. However, while identifying alternate crops, supply chain of crop produce needs to be mapped and ensure that the suggested alternate crop produce has adequate market.
- State agricultural department through its extension services alternate livelihood options suitable need to be explored taking into consideration the waterlogging issues.
- State agriculture department through farmer cooperatives and agri-business companies should promote crop insurance as safety net for the community.

- State WRD in coordination with CWC and IMD should improve the effectiveness of early warning system to reduce the flood risks.
- State agricultural department should providing agro-advisory based on weather forecast (for season) can help farmers to plan their agriculture calendar.
- State Revenue Department in coordination with WRD should enforcement strict landuse practices on the river side of the embankment (no permanent structures) to reduce casualty and loss.
- Local administration with the support of local NGOs/CBOs should work with communities for developing channel in waterlogging areas to make the land suitable for agriculture.
- The local administration should utilise the development funds along with community contribution and participation to constructing channel to resolve localised waterlogging issues.

Appendix A: FDG Summary Reports

Village: Rankodih, Tehsil: Khagaria, Dist: Khagaria, Bihar

1.0	Village Profile	
1.1	Population	3000 (500 HH)
1.2	Area	150 Acres (Approx)
1.3	Location of the River	Bagmati, towards 4 km North
1.4	Occupation/livelihood	Agriculture
2.0	Flood hazard profiling	
2.1	How often do you have a flood? How long does a flood normally last? To what height the water reached?	In 2007, the village got affected by flood for 3 months. Recently in 2014, flood again struck the village damaging some houses, agricultural, etc.
2.2	What are the major disasters occurred in this village?	Flood of 2007 which caused extensive loss of livelihood to the villagers.
2.3	What is the most devastated disaster occurred in the recent past say last 10 years in your area?	Flood of 2007
2.4	How it affected the village and in what extent? What was the health impact? What was the extent of damages on the crop and livestock? Did it affect the soil?	It affected the village in many ways like damaging houses, and causing loss of cattle, boats, and even human lives.
2.5	What was the major loss in terms of lives and assets due to that devastated disaster? Did you receive help from outside in terms of relief funds, equipment, housing material etc. to recover from the losses? How long did it take to be back to the situation before the disaster (in terms of assets such as livestock, house, and in terms of income)?	Losses include homes, food material, fuel and other materials. Some of them also lost their family members. The flood also caused health problems - water borne diseases. As flood relief measure, affected people received 1 kg cereals per household. For the community, it takes almost 3-4 months to come back to the normal situation.
3.0	Flood benefit if any	
3.1	Understand the perception of community towards flood. Whether they believe flood is a problem or phenomena which also bring in benefits? If so what?	There is no benefit. Only it is creating long term problem due to water logging.

3.2	Compare a situation with regular flood and without flood due to flood protection measures. Which is a preferred one?	Community prefer to have a situation without flood as flood hampers their lives and livelihoods.
3.3	Does flood has any beneficial effect on the crops? Whether flood in one season (say during Kharif season) is beneficial for the crops during next cropping season (i.e., Rabi season crops) in terms of water availability or soil moisture availability for the crops?	There is no benefit of flood to crops.
4.0	Changes over the last 20 years (flood, pattern of rain, etc)	
4.1	Did you observe any changes in the rainfall distribution pattern and flood characteristics in your region? Please ask with example of increase/ decrease in rain and duration of rain during particular month/season or monsoon reaching early/late, etc. If the answer towards this is 'yes' continue on this topic asking questions like – Are you taking any adaptation measures to adjust to the changes in the rainfall. If so what are they? (Some of the measures are moving away from flood affected area to the safer place, changing in the cropping pattern, changing in the cropping calendar, etc)	Rainfall pattern has changed. It is difficult to predict when rain comes. There is a decline in rainfall and in the frequency of flood. It is felt that the rainy season has shifted ahead by 1-2 months.
5.0	Flood mitigation measure	
5.1	With the help of the community identify flood affected areas, flood control measures in the village (embankments, improvement in the drainage system, sluice gate, etc.) and its present conditions. In case the community is suggesting for new structural mitigation measures take the discussion further to understand the cost benefit of the	The affected area of the village is situated in the northern part (towards school) of the village which is low lying agricultural lands. Usually flood water comes from that direction. There should be proper management of Rosera Embankment on river Bagamti, Gandak, and Koshi. There should be a huge pipe/channel in the water

	measures, issues that can happen, any limitation, to understand whether the community foresee all aspects before suggesting such thing. And how to organize implementing such measure: who should take the lead, government or community?	logged areas of the village to take out the water. Government should take initiatives for flood mitigation measures.
6.0	Planning and decision making	
6.1	Do villagers know who to approach at the government with regard to flood management issues? Is there regular communication with local government on flood issues, mitigating measures? Are ideas and local knowledge appreciated by government? Are you in general content with the communication with government? Are local villagers consulted or involved when government prepares measures for flood mitigation, such as embankment construction or rehabilitation? If so, how is this organised. If not, what do you think of this? How should this be changed?	The villagers never approached the government for any kind of mitigation measures for flood. They submitted an application to the District Magistrate for relief fund once. As per community, embankments on the river are fine but they want their proper maintenance and flood monitoring.
7.0	Community flood mitigation and adaptation initiative	
7.1	What is the present mechanism of informing the community on flood alert, frequency and its effectiveness?	Information on flood are received through local newspapers, television, and people from nearby villages.
7.2	Whether community wait for information or take own decision	They take their initiatives individually and migrate to NH-1 or Khagaria Bazar.
7.3	What kind of initiative government has taken to help the flood management in your village	There is no initiative taken by government for this village.
7.4	What kind of initiatives communities and community based organization are taking to manage the flood – like awareness where to live, and how to protect assets, how to protect the crops (standing/harvested), how to reclaim the soil if soil health has been deteriorated due to the silt carried	No safety measures for flood from the govt. Community act as per their knowledge and ability.

	along with flood water, village level DM committees/village committee to inspect embankment/ sluice gate before monsoon/rainy season, etc.	
7.5	Effectiveness of government mechanism in response, rescue, and relief operations.	No such initiatives have been taken for relief operations.
8.0	Steps needed for protecting from flood	
8.1	What Govt. should do to minimise the flood induced negative impacts in the area such as human lives, house, crops, livestock, etc?	Government should take initiatives like proper management of embankments, flood shelter area, relief fund, pipe for allowing rain water to pass while construction across drainage channels, etc.
8.2	What community can and should do for flood risk management to avoid lives and assets (house, crops, and livestock) losses from floods?	They will help if anybody works for the betterment of their village. They will give complete support from the village.

Village+Panchyat: Lodipur, P.S+Tehsil: Goraul, Dist: Vaishali, Bihar: FDG Women Group

1.0	Village Profile	
1.1	Population	3000 (500 HH)
1.2	Area	200 Acer (Approx.)
1.3	Location of the River	Baya River, 3 Km in West.
1.4	Occupation/livelihood	Agriculture & Cattle
2.0	Flood hazard profiling	
2.1	How often do you have a flood? How long does a flood normally last? To what height the water reached?	In the last 30 years, there were four major flood incidents the village faced in 1987, 2002, 2004, and 2007. It affected mainly the agriculture area of the village; the 1987 flood was severe and the flood height in the village was almost 2 m.
2.2	What are the major disasters occurred in this village?	No major disaster occurred in this village; but they face problems due to water logging in the agricultural land every year.
2.3	What is the most devastated disaster occurred in the recent past say last 10 years in your area?	No disaster occurred after 1987 flood, which caused severe damage.
2.4	How it affected the village and in what extent? What was the health impact?	There is no special arrangement for women in the village during floods. Insects and reptiles are one of

	What was the extent of damages on the crop and livestock? Did it affect the soil?	the major threats during the flood. There are only 25% HH which have their own latrines. One of the major problems during the flood is water which is everywhere and people cannot go outside for toilet in the early morning or night. Most of the times they experienced cough and cold, fever, typhoid, cholera and other water borne diseases. For medicines, they mostly go to the private medical store during flood.
2.5	What was the major loss in terms of lives and assets due to that devastated disaster? Did you receive help from outside in terms of relief funds, equipment, housing material etc. to recover from the losses? How long did it take to be back to the situation before the disaster (in terms of assets such as livestock, house, and in terms of income)?	The village didn't experience flood since 1987. However, the village faces water logging problems in agricultural land.
3.0	Flood benefit if any	
3.1	Understand the perception of community towards flood. Whether they believe flood is a problem or phenomena which also bring in benefits? If so what?	No benefit only cause problem due to water logging.
3.2	Compare a situation with regular flood and without flood due to flood protection measures. Which is a preferred one?	According to the farmers, in 1993 and 1996 the agriculture land was not affected by water logging due to less water in the river & rain. That was a positive situation for the village as far as agriculture and occupation are concerned. After 1996, there is continuous water logging in this area, so they are unable to take any benefit from the land.
3.3	Does flood has any beneficial effect on the crops? Whether flood in one season (say during Kharif season) is beneficial for the crops during next cropping season (i.e., Rabi season crops) in terms of water availability or soil moisture availability for the crops?	As per them, there is no beneficial effect of flood on crops. It only causes water logging.
4.0	Changes over the last 20 years (flood, pattern of rain, etc.)	

4.1	Did you observe any changes in the rainfall distribution pattern and flood characteristics in your region? Please ask with example of increase/ decrease in rain and duration of rain during particular month/season or monsoon reaching early/late, etc. If the answer towards this is 'yes' continue on this topic asking questions like – Are you taking any adaptation measures to adjust to the changes in the rainfall. If so what are they? (Some of the measures are moving away from flood affected area to the safer place, changing in the cropping pattern, changing in the cropping calendar, etc)	In our discussion we found that there were droughts before 1990, after that floods increased, except in 1993 and 1996. In both the situations, agriculture got affected the most. During drought they were unable to irrigate land by canal or bore well and flood causes water logging in the agricultural land. Lot of agriculture land are under water logging situation almost all month except 2 months in summer which is not sufficient to grow crops. For the last 20 years almost, monsoon is delayed by one to one and half months. They don't have any cropping calendar as a mitigation measure for flood.
5.0	Flood mitigation measure	
5.1	With the help of the community identify flood affected areas, flood control measures in the village (embankments, improvement in the drainage system, sluice gate, etc.) and its present conditions. In case the community is suggesting for new structural mitigation measures take the discussion further to understand the cost benefit of the measures, issues that can happen, any limitation, to understand whether the community foresee all aspects before suggesting such thing. And how to organise implementing such measure: who should take the lead, government or community?	The flood affected area of this village is at the back side of the village which means water logging occurs every year in agriculture land. According to the villagers, there are two canals (Gandak Project/Damodarpur canal & Turhut Main Canal). The channels are silted and bed level is now higher that the adjacent agriculture land causing water logging situation during rainy season. Community needs some arrangement for the water to pass through canal properly.
6.0	Planning and decision making	
6.1	Do villagers know who to approach at the government with regard to flood management issues? Is there regular communication with local government	Some of the villagers approached the circle officer regarding mitigation measures for water logging. Villagers had not been involved in any such activities but they are agreed that if the government or any

	on flood issues, mitigating measures? Are ideas and local knowledge appreciated by government? Are you in general content with the communication with government? Are local villagers consulted or involved when government prepares measures for flood mitigation, such as embankment construction or rehabilitation? If so, how is this organised. If not, what do you think of this? How should this be changed?	other body will work for them they will help them.
7.0	Community flood mitigation and adaptation initiative	
7.1	What is the present mechanism of informing the community on flood alert, frequency and its effectiveness?	There has been no flood situation in the recent past. However, the village does not have any early warning system.
7.2	Whether community wait for information or take own decision	No, They take self/individual decisions for their safety.
7.3	What kind of initiative government has taken to help the flood management in your village	There is no initiative taken by the government for this village.
7.4	What kind of initiatives communities and community based organization are taking to manage the flood – like awareness where to live, and how to protect assets, how to protect the crops (standing/harvested), how to reclaim the soil if soil health has been deteriorated due to the silt carried along with flood water, village level DM committees/village committee to inspect embankment/ sluice gate before monsoon/rainy season, etc.	No activity for safety from flood. They act according to their knowledge and adaptability.
7.5	Effectiveness of government mechanism in response, rescue, and relief operations.	They are completely unsatisfied with the Government response regarding flood rescue/safety and agriculture related issues.
8.0	Steps needed for protecting from flood	
8.1	What Govt. should do to minimize the flood induced negative impacts in the	They should work for water management issues of the village. They should make some arrangements so that

	area such as human lives, house, crops, livestock, etc?	their agriculture fields are not waterlogged and ensure water availability in canals on time.
8.2	What community can and should do for flood risk management to avoid lives and assets (house, crops, and livestock) losses from floods?	They will help any organization/government, if they work for their issues. They are also ready to work at community level (Community Farming).

Note:

This village has a very large area. We have conducted FGD in the back part of the village, which is the nearest point to the river and most affected part of the village.

This village is affected by both flood and drought.

Agricultural lands are water logged.

There is a shift in weather but still they used to start their cultivation at the usual time by providing water through pump sets. But they completely depend upon rain for agriculture.

The land not affected due to water logging, there is problem of lack of water delay or unavailability of water in canal (Gandak Project Canal & Tirhut Canal).

Government body used to provide paddy seeds after the season lapsed.

The availability of wheat seeds are at higher prices than the market.

One of the major problems in agriculture is that crops are destroyed by wild-pig and neel-gay.

No "ladies doctor" visits the village.

Recommendations from Women's Group

There should be some arrangement for a safe place inside the village during flood.

Arrangement of medical facilities nearby.

Awareness program should be there to teach them about how to protect from flood.

There should be some common latrines in the village for ladies or if possible, individual ones at home.

During floods, there should be doctors for ladies and children.

Village: Kalyanpur, P.S+Tehsil: Kalyanpur, Dist: Samastipur, Bihar: FGD: Women Group

1.0	Village Profile	
1.1	Population	6000 (600HH)
1.2	Area	105 Acre (Approx.)
1.3	Location of the river	Burhi-Gandak : Approx. 2 Km towards SW. Bagmati: Approx. 7.5 Km towards NE.
1.4	Occupation/livelihood	Agriculture & Livestock

2.0	Flood hazard profiling	
2.1	How often do you have a flood? How long does a flood normally last? To what height the water reached?	In last 30 years, there were four major flood incidents the village faced - in 1987, 2002, 2004, and 2007. Flood normally lasted for 20-25 days in the residential and 50-60 days in agriculture land. Generally in the residential areas, average height of water was 1.5m and in the agriculture land height of water was more than 4m.
2.2	What are the major disasters occurred in this village?	In the year 2004 and 2007, floods occurred in the village due to embankment breach in both rivers. In the 2007 flood, four people died due to flash flood. 13-15 people died because of diarrhoea. Sudden flooding caused asset damage and agricultural produce damage stored in the houses etc.
2.3	What is the most devastated disaster occurred in the recent past say last 10 years in your area?	The most devastating disaster that occurred in the past 10 year was the flood of 2007, which affected livelihood and agriculture practices.
2.4	How it affected the village and in what extent? What was the health impact? What was the extent of damages on the crop and livestock? Did it affect the soil?	In 2007, water level reached almost 1.5m to 2m and stayed for a week, which destroyed food stocks in the houses, and families of kutcha/semi kutcha houses were shifted to the terrace of neighbours with pucca houses. There is no special arrangement for women in the village during flood. A major difficulty was to go outside for toilet in the early morning or night. There were only 50-60% house which has their own toilets. So, they faced problems like infection and other health related problems. They feared that their children would sink in the flood water or would get affected by diseases. Villagers shifted their animals to elevated places and during floods they used Boats (locally known as Dengi) to bring fodder (at that time only Bamboo, Pepal, Jackfruit leaves are available as fodder) for the cattle. The 2007 flood extensively affected the paddy crops. The floods affect 80% to 90% of paddy fields were covered by the flood water. Now, they go for paddy cultivation in a very small upland area of the village. During heavy rain and flood time, the community affected almost every year with cough and cold, fever, typhoid, cholera and other water borne diseases that

		occur during floods. During the 2007 flood there was wide spread of livestock disease and kill lot of cows. Due to water logging, a lot of mango trees and shesam trees were destroyed. In Kalyanpur, there were both negative and positive effects on the agricultural fields from floods. If floods occur from the Gandak river, it carries sand, which causes sand casting. But in case flood occurs from the Bagmati river, it carries silt which increases the soil productivity.
2.5	What was the major loss in terms of lives and assets due to that devastated disaster? Did you receive help from outside in terms of relief funds, equipment, housing material etc. to recover from the losses? How long did it take to be back to the situation before the disaster (in terms of assets such as livestock, house, and in terms of income)?	The major loss in terms of lives and assets were due to cattle deaths, stored grain damage, house damage, agricultural damage (Crop- Paddy). They did not receive any relief funds, equipment, housing material, training etc. from government or any other organizations to recover from the losses. After the disaster, villagers took average 30-40 days to get back to the pre-disaster situation. But in terms of income, small farmers lose their assets (due to damage of crop) and it normally takes longer to recover from.
3.0	Flood benefit if any	
3.1	Understand the perception of community towards flood. Whether they believe flood is a problem or phenomena which also bring in benefits? If so what?	According to the villagers, flood is beneficial for their crop (fertility of soil) but it hampers their daily life and assets when flood water enters the village.
3.2	Compare a situation with regular flood and without flood due to flood protection measures. Which is a preferred one?	As per the community, some of their agricultural area remains waterlogged (height of water is approx 1-2 meters) waterlogging problem on both sides of Darbhanga-Samastipur road. Since 2007, farmers are facing problems of lack of water (irrigation) and they hire water pumps which add to the cost of farming.
3.3	Does flood has any beneficial effect on the crops? Whether flood in one season (say during Kharif season) is beneficial for the crops during next cropping season (i.e., Rabi season crops) in terms of water availability or soil moisture availability for the crops?	Bagmati river brings silt, even though cause flooding as well, and is helpful for agriculture. One of the farmers told that since 2007, the fertilizer consumption has increased 4-5 times. But in case of floods from the Burhi Gandak river, sand casting occurs, which decreases the fertility of the soil.

4.0	Changes over the last 20 years (flood, pattern of rain, etc)	
4.1	Did you observe any changes in the rainfall distribution pattern and flood characteristics in your region? Please ask with example of increase/ decrease in rain and duration of rain during particular month/season or monsoon reaching early/late, etc. If the answer towards this is 'yes' continue on this topic asking questions like – Are you taking any adaptation measures to adjust to the changes in the rainfall. If so what are they? (Some of the measures are moving away from flood affected area to the safer place, changing in the cropping pattern, changing in the cropping calendar, etc)	According to community, they observed that the rainfall is starting late by 30 to 45 days. The rainy season has shifted from June to July. Even the rainfall has decreased in the last 20 years. Community is not taking any adaptation measures to adjust the change or reduction in rainfall.
5.0	Flood mitigation measure	
5.1	With the help of the community identify flood affected areas, flood control measures in the village (embankments, improvement in the drainage system, sluice gate, etc.) and its present conditions. In case the community is suggesting for new structural mitigation measures take the discussion further to understand the cost benefit of the measures, issues that can happen, any limitation, to understand whether the community foresee all aspects before suggesting such thing. And how to organise implementing such measure: who should take the lead, government or community?	According to the community, the 2007 flood, the whole village, agriculture area, block Hospital (Near Kalyanpur square, marked in Annexure I) were affected due to flood. According to them, the embankment height is good enough but needs maintenance at some places. There should be embankment between 0 Miles (Dadheri) to Saidpur. It need proper drainage (huge pipes across the road) to avoid waterlogging at Darbhanga-Samastipur road (between Kalyanpur to Jatmalpur).
6.0	Planning and decision making	
6.1	Do villagers know who to approach at the government with regard to flood management issues? Is there regular communication with local government on flood issues, mitigating measures?	They are not aware about any government plan regarding flood management. They have no knowledge about where and how to approach as they have never approached any government department. They also told that there is no participation of the

	Are ideas and local knowledge appreciated by government? Are you in general content with the communication with government? Are local villagers consulted or involved when government prepares measures for flood mitigation, such as embankment construction or rehabilitation? If so, how is this organised. If not, what do you think of this? How should this be changed?	government in flood mitigation activities in village. Villagers have also not participated in any flood management program organized by the government. According to villagers, they will support and participate in such programs to mitigate the problems from flood.
7.0	Community flood mitigation and adaptation initiative	
7.1	What is the present mechanism of informing the community on flood alert, frequency and its effectiveness?	There is no EWS mechanism. In case villagers observe rise in water level or breach of embankment they will inform others through mobile phone and meeting people. Sometimes block level Circle Officer also makes an announcement to be prepared for flood.
7.2	Whether community wait for information or take own decision	Community takes its own decision as most of the time as floods occur mostly suddenly and at night. They are unable to keep safe their harvested crops and other items and they move to elevated area (mostly to the roof of pucca houses in the village) with their food. Cattle are also moved to elevated places like roads, schools etc.
7.3	What kind of initiative government has taken to help the flood management in your village	According to them, there is no initiative taken to help in flood management in this village.
7.4	What kind of initiatives communities and community based organization are taking to manage the flood – like awareness where to live, and how to protect assets, how to protect the crops (standing/harvested), how to reclaim the soil if soil health has been deteriorated due to the silt carried along with flood water, village level DM committees/village committee to inspect embankment/ sluice gate before monsoon/rainy season, etc.	No activity for safety from floods.
7.5	Effectiveness of government mechanism in response, rescue, and relief	Government body is inactive in response and rescue. As relief fund, they get some rice and wheat after

	operations.	flood (relief fund is accessible to only 50% of villagers)
8.0	Steps needed for protecting from flood	
8.1	What Govt. should do to minimise the flood induced negative impacts in the area such as human lives, house, crops, livestock, etc.?	Government should make shelters; and make arrangements for food, fodder for cattle, better medical facilities during and after floods. Government should do something to avoid the waterlogging caused due to the construction of road between Kalyanpur to Jatmalpur on Samstipur-Jatmalpur Road. They also want training in handling boats, first aid, new agriculture techniques, and disaster management. For betterment of agriculture, government should provide fertilizer at regular market rates.
8.2	What community can and should do for flood risk management to avoid lives and assets (house, crops, and livestock) losses from floods?	As per the community they will work with the government if it is for the welfare of the village. They also want to do community farming if someone guides them about new agriculture techniques.

Note:

At Mirjapur there is bridge/canal where fishermen block the water flow for fishing, which also causes water logging in the agriculture area of Kalyanpur. Villagers once went to tell them to open but the fishermen refused.

In this village, the government has recruited one "Kishan Salahkar" but he hasn't helped any farmers and does not share any information about weather predictions and Government schemes.

During floods, villagers used to drink flood water after boiling it. During flood they also go for toilet on/besides the road.

Now, due to crop (mostly paddy) damage from floods, Farmers use only 10-20 % of the area for paddy cultivation and the rest used for growing fire wood.

Need an Embankment near Zero Mile (Dareri Village) or Zero miles to Saidpur.

Need drainage (big pipes) across Jatmalpur to Samastipur road for draining the water and avoid waterlogging. Presently the obstruction of the road is causing waterlogging situation.

Farmers do not get seeds and fertilizer at the proper time and cost (farmers have to pay 40% more cost on fertilizer, if they buy from the market) and due to middle men in market they don't get the best price for their crop.

The village has poor access to medical facility. The block office use to support this but most of the time they don't have stock.

No lady doctor visiting the village.

Village: Hardia, Tehsil: Raxaul, Dist: East Champaran, Bihar

1.0	Village Profile	
1.1	Population	2000 (300 HH)
1.2	Area	
1.3	Location of the River	Sariska river in the SE of the village
1.4	Occupation/livelihood	Agriculture
2.0	Flood hazard profiling	
2.1	How often do you have a flood? How long does a flood normally last? To what height the water reached?	Every year flood affects this village. Flood water of almost 2 m height inundates the agricultural land of the village every year.
2.2	What are the major disasters occurred in this village?	In 1986, flood water entered the village and damaged houses and assets.
2.3	What is the most devastated disaster occurred in the recent past say last 10 years in your area?	No such disaster occurred in the last 10 years.
2.4	How it affected the village and in what extent? What was the health impact? What was the extent of damages on the crop and livestock? Did it affect the soil?	Last major flood occurred in 1986, in which lot of assets got damaged. Two boys, cows, buffalos and goats drowned in the flood water. Some of the villagers were affected by waterborne diseases like diaherra, cold and cough, vomiting etc. Paddy crops were affected largely in this village. However, no such effect on soil quality was observed.
2.5	What was the major loss in terms of lives and assets due to that devastated disaster? Did you receive help from outside in terms of relief funds, equipment, housing material etc. to recover from the losses? How long did it take to be back to the situation before the disaster (in terms of assets such as livestock, house, and in terms of income)?	Due to 1986 flood, approx. 40-50 houses collapsed. Paddy was the main crop which got severely damaged due to that flood.
3.0	Flood benefit if any	
3.1	Understand the perception of community towards flood. Whether they believe flood is a problem or phenomena which also bring in	According to the community, flood is the major problem the village faces, which has serious implications in terms of house damages, agriculture damages, etc.

	benefits? If so what?	
3.2	Compare a situation with regular flood and without flood due to flood protection measures. Which is a preferred one?	As per them, the situation without flood is better for the village. When flood comes in the river situated SE of the village, it causes erosion of the banks. Houses near or at the river bank use to collapse as the result.
3.3	Does flood has any beneficial effect on the crops? Whether flood in one season (say during Kharif season) is beneficial for the crops during next cropping season (i.e., Rabi season crops) in terms of water availability or soil moisture availability for the crops?	There is no benefit of flood to agriculture.
4.0	Changes over the last 20 years (flood, pattern of rain, etc)	
4.1	Did you observe any changes in the rainfall distribution pattern and flood characteristics in your region? Please ask with example of increase/ decrease in rain and duration of rain during particular month/season or monsoon reaching early/late, etc. If the answer towards this is 'yes' continue on this topic asking questions like – Are you taking any adaptation measures to adjust to the changes in the rainfall. If so what are they? (Some of the measures are moving away from flood affected area to the safer place, changing in the cropping pattern, changing in the cropping calendar, etc)	As per discussions, rainfall and the frequency of flood has decreased in the village over the last 10-15 years. Whenever heavy rain occurs in Nepal (upper reaches), the river overflows in around 24 hr.
5.0	Flood mitigation measure	
5.1	With the help of the community identify flood affected areas, flood control measures in the village (embankments, improvement in the drainage system, sluice gate, etc.) and its present conditions. In case the community is suggesting for new structural mitigation	25% of agriculture land is located on the opposite river bank (Sariska River). So, there should be a bridge to cross the river. There should be check-dam/sluice gate in the river. There should be an arrangement of water pump in the village for agriculture land on the south and north sides of village in the summer season. There should be training on modern agriculture to

	measures take the discussion further to understand the cost benefit of the measures, issues that can happen, any limitation, to understand whether the community foresee all aspects before suggesting such thing. And how to organise implementing such measure: who should take the lead, government or community?	improve the quality and quantity.
6.0	Planning and decision making	
6.1	Do villagers know who to approach at the government with regard to flood management issues? Is there regular communication with local government on flood issues, mitigating measures? Are ideas and local knowledge appreciated by government? Are you in general content with the communication with government? Are local villagers consulted or involved when government prepares measures for flood mitigation, such as embankment construction or rehabilitation? If so, how is this organised. If not, what do you think of this? How should this be changed?	Some of the villagers approached local MLA to apprise on the issues related to flood. During the flood, community offices and block development officers used to visit the affected areas but no initiatives have been taken by them as reported by the villagers. There is no community consultation in the village for proper flood management. They were involved in making a small embankment for irrigation purpose.
7.0	Community flood mitigation and adaptation initiative	
7.1	What is the present mechanism of informing the community on flood alert, frequency and its effectiveness?	Villagers usually get flood related alerts through community as they observation water level in the river.
7.2	Whether community wait for information or take own decision	No, they take their own decisions for their safety based on community experience.
7.3	What kind of initiative government has taken to help the flood management in your village	There is no significant initiative taken by the government for this village.
7.4	What kind of initiatives communities and community based organisation are taking to manage the flood – like awareness where to live, and how to protect assets, how to protect the crops	No initiative/activity with regard to the safety from flood. What they do is solely based on their knowledge and adaptability.

	(standing/harvested), how to reclaim the soil if soil health has been deteriorated due to the silt carried along with flood water, village level DM committees/village committee to inspect embankment/ sluice gate before monsoon/rainy season, etc.	
7.5	Effectiveness of government mechanism in response, rescue, and relief operations.	They are completely unsatisfied with the Government response regarding flood rescue/safety and agriculture related issues.
8.0	Steps needed for protecting from flood	
8.1	What Govt. should do to minimize the flood induced negative impacts in the area such as human lives, house, crops, livestock, etc?	Government should take care of the needs of the village to safeguard it from the flood; like building an embankment on the river, and providing sluice gate, water pumps, etc. and if possible they should also work on the drainage system of the village.
8.2	What community can and should do for flood risk management to avoid lives and assets (house, crops, and livestock) losses from floods?	They are ready to help any organisation/government, if they work for solving their issues. They are also ready to work at community level (Community farming).

Village:Ward no.1, Dumaria, Tehsil: Narkatiaganj, Dist: West Champaran, Bihar

1.0	Village Profile	
1.1	Population	2500 (550 HH)
1.2	Area	
1.3	Location of the River	Ramrekha River (nearest from village)
1.4	Occupation/livelihood	Labour and agriculture
2.0	Flood hazard profiling	
2.1	How often do you have a flood? How long does a flood normally last? To what height the water reached?	In last 30 years, the village faced only one flood i.e. in 1987. (Some nearby villages such as Muraira, Mahuvi, Daimarwa, bahuari, Bhaw, Chamardih, Baragaw etc. were affected by flood.)
2.2	What are the major disasters occurred in this village?	Village is mainly affected by drought, due to low availability of water for agriculture. The nearest canal from village is Trivani Canal and there is no water into it after 1980 as per the villagers.
2.3	What is the most devastated disaster	No disaster occurred after 1987 flood, but after this

	occurred in the recent past say last 10 years in your area?	the village is continuously facing drought situation for agriculture.
2.4	How it affected the village and in what extent? What was the health impact? What was the extent of damages on the crop and livestock? Did it affect the soil?	N/A
2.5	What was the major loss in terms of lives and assets due to that devastated disaster? Did you receive help from outside in terms of relief funds, equipment, housing material etc. to recover from the losses? How long did it take to be back to the situation before the disaster (in terms of assets such as livestock, house, and in terms of income)?	NA
3.0	Flood benefit if any	
3.1	Understand the perception of community towards flood. Whether they believe flood is a problem or phenomena which also bring in benefits? If so what?	NA
3.2	Compare a situation with regular flood and without flood due to flood protection measures. Which is a preferred one?	NA
3.3	Does flood has any beneficial effect on the crops? Whether flood in one season (say during Kharif season) is beneficial for the crops during next cropping season (i.e., Rabi season crops) in terms of water availability or soil moisture availability for the crops?	NA
4.0	Changes over the last 20 years (flood, pattern of rain, etc)	
4.1	Did you observe any changes in the rainfall distribution pattern and flood characteristics in your region? Please ask with example of increase/ decrease in rain and duration of rain during particular month/season or monsoon	In our discussion, we found that there is an apparent decrease in the flow of water and water level of the river. Decrease in crop productivity was observed due to less rainfall. Crop gets damaged due to pre or post monsoon. In 2014, due to some effect of Hudhud storm, sugarcane crops got damaged at large scale.

	reaching early/late, etc. If the answer towards this is 'yes' continue on this topic asking questions like – Are you taking any adaptation measures to adjust to the changes in the rainfall. If so what are they? (Some of the measures are moving away from flood affected area to the safer place, changing in the cropping pattern, changing in the cropping calendar, etc)	
5.0	Flood mitigation measure	
5.1	With the help of the community identify flood affected areas, flood control measures in the village (embankments, improvement in the drainage system, sluice gate, etc.) and its present conditions. In case the community is suggesting for new structural mitigation measures take the discussion further to understand the cost benefit of the measures, issues that can happen, any limitation, to understand whether the community foresee all aspects before suggesting such thing. And how to organise implementing such measure: who should take the lead, government or community?	NA
6.0	Planning and decision making	
6.1	Do villagers know who to approach at the government with regard to flood management issues? Is there regular communication with local government on flood issues, mitigating measures? Are ideas and local knowledge appreciated by government? Are you in general content with the	NA

	communication with government? Are local villagers consulted or involved when government prepares measures for flood mitigation, such as embankment construction or rehabilitation? If so, how is this organised. If not, what do you think of this? How should this be changed?	
7.0	Community flood mitigation and adaptation initiative	
7.1	What is the present mechanism of informing the community on flood alert, frequency and its effectiveness?	NA
7.2	Whether community wait for information or take own decision	NA
7.3	What kind of initiative government has taken to help the flood management in your village	NA
7.4	What kind of initiatives communities and community based organization are taking to manage the flood – like awareness where to live, and how to protect assets, how to protect the crops (standing/harvested), how to reclaim the soil if soil health has been deteriorated due to the silt carried along with flood water, village level DM committees/village committee to inspect embankment/ sluice gate before monsoon/rainy season, etc.	NA
7.5	Effectiveness of government mechanism in response, rescue, and relief operations.	NA
8.0	Steps needed for protecting from flood	
8.1	What Govt. should do to minimize the flood induced negative impacts in the area such as human lives, house, crops, livestock, etc?	NA
8.2	What community can and should do for flood risk management to avoid lives and assets (house, crops, and livestock)	NA

	losses from floods?	

Note:

This village is mostly affected by drought.

Failure of Trivani canal (water didn't flow after 1980) and low rainfall affect agriculture.

They need check-dam in Ramrekha River (nearest from village).

Tube-wells in the agricultural area for water availability.

Farmers mostly use organic manure made by themselves in farmland.

Use of fertilizers in paddy - urea 7 kg/Kattha, DAP+K+urea= 6kg/kattha (1 kattha= 2000 sq ft)

Average productivity 160kg Paddy/kattha, 200kg Wheat/Kattha, 4000-5000kg Sugarcane /Kattha.

Field Photographs

Appendix B: Questionnaire format English version

Form number:			

Operational Research to Support Mainstreaming of IFM under Climate Change - Phase II
Community household survey questionnaire

1. Identifiers

1.1 State		**1.7** Date of interview	
1.2 District		**1.8** Name of enumerator	
1.3 Block		**1.9** Interviewee	
1.4 Village		**1.10** Relation to HH Head	

2. Household information

2.1 Name of Head of household:	**2.2** Sex: M/F	**2.3** Number of members living in the house: Male: Female:	
2.4: Group: SC/ST/Others		**2.5** Number of Age <6: **2.6** Age > 60 **2.7** Disabled/chornic disease person:	
2.8. Number of adult with highest education in HH (living in the location)	Iliterate	Below 10th	Graduate
	Post graduate	Techinical (diploma/degree in engineering etc)	

2.9 Housing materials

Roof material:	grass ☐	Palm leaves ☐	Plastic sheet ☐	Wood ☐	Concrete ☐	Tile ☐	Iron sheet ☐
Wall material:	grass ☐	Palm leaves ☐	Plastic sheet ☐	Wood ☐	Brick-Cement ☐	Brick-Mud ☐	Mud ☐
Floor material:	Mud ☐	Brick ☐	Bamboo ☐	Wood ☐	Cement ☐	Tile ☐	

2.10 Location of the house: (a) River bed, (b) flood plain, (c) elevated land on flood plan, (d) On embankment, (e) on the protected side of embankment, (f) Others specify:

2.11 Age of the house: **2.12** Cost of construction of the house:

2.13 Plinth height: (a) ground level, (b) <1 mt, (c) 1-2 mts (d) > 2 mts

3. Household Assets

3.1 Please indicate which of the following assets you own *[Enumerator: Use questions and observation. Mention quantity applicable. If not available mark 'x'. Don't leave any blanks.]*

Asset	Number	**Asset**	Number	**Asset**	Number	**Asset**	Number
Flush toilet		Bicycle		Fishing net		Cattle	
Pit Latrine		Motorbike		Water tank		Buffalo	
TV		Car/truck		Dug well		Goat	
Landline phone		Tractor		Drill well:handpump		Poultry	
Mobile phone		Ox cart		Drill well:electric		Pigs	
Fridge		Boat with no engine		Irrigation equipment			
Airco		Boat with engine		Rice mill		Money on bank	
				Thresher		Jewelry	
				Water pump		Capital lend out	

3.2 Details of agriculture land

S. no.	Agriculture use	Area	Number of crops a year	Crop (Kg)	Own consumption or sale	Average income from crops

1

3.3 Main source of income of household in the order 1 to 5

Sale of Crop produce		Main source = 1 Second source = 2 Third source = 3 Fourth source = 4 Fifth source = 5
Sales livestock		
Fishing		
HH member has a job		
HH has a business		
Income Casual Labor		
Other		

3.4 Average monthly household income in Rs:

<1000	1001-3000	3000-5000	5000-10000	<10000

3.5 Approx. amount spent per month:
3.6 Approx. amount saved per annum:
3.7 If you have loan/debt amount Rs.

4. Access to (public) facilities

4.1 Please indicate if you have actual access to the following facilities:

	Y	N		Y	N
Do you have at your home:			**If you need, can you make use of:**		
Piped water supply (in house)			Micro-credit facilities		
Private well			Credit from money lender		
Electricity from grid			Credit from bank		
Electricity from communal generator			LP school		
Electricity from private generator			UP school		
			Other school:…..		
Do you have access to:			Doctor		
Communal tap			Agriculture training/extension		
Communal well					
Other water source (rain, river, pond)					
Public latrine					

4.2 What is the distance from your home to nearest health post / health centre: <1 Km, 1-2 km, 2-5 km > 5Km

4.3 What is the distance from your home to nearest (referal) hospital: <1 Km, 1-2 km, 2-5 km > 5Km

4.4 What is the distance from your home to the year-round (metalled/ concrete) road: <1 Km, 1-2 km, 2-5 km > 5Km

5. Problems and issues related to environment

5.1 According to you what is the main problem in the village (top two and mark in the order of prioity as 1 and 2)

Flood		No water		Sand casting in field		Other:	

5.2 What need to be done to minimize flood problems (Y is applicable). Answer atleast three.

Strengthening of Embankments		Lift irrigation for irrigating field in summer	
Water regulators to control intake and discharge of water		Provide training in agriculture to cope with floods	
Proper drainage facility		More relief funds	
Proper water discharge mechanism from the low lying areas		Mechanism to remove sand cast from agriculture fields	
Weather forecast and warning dissemination		Agriculture insurance:	
Involvement in Flood management planning		Others:	
Construction of flood shelters		Others:	

6. Flood hazard

Nr.	Hazard characteristic				Duration of flood event	Cause of flood	Houses		Agriculture				People								
	Year / month	Flood – F	Flood height at home	Flood height in agri land			House damaged (P – partial, C – complete)	Assets destroyed	Livestock died		Crops destroyed		Nr of people affected	Injured - Child, Elder, Disabled, Other (provide numbers)				Died - Child, Elder, Disabled, Other (provide numbers)			
									Type	Nr	Type	Area Hectre		C	E	D	O	C	E	D	O
1													M								
													F								
2													M								
													F								
3													M								
													F								

Cause of flood – R: Heavy/continous rain, C: cyclone rain, O: overflow of embankment, B: breach of embankment, D: People delibrately break embankment, FF: Flash flood, T: tidal flood

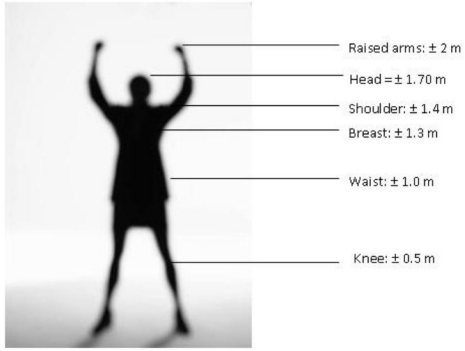
C: cattle, B: Baffalo, G: Goat, H: Poultry, P: Pig, Others specify

3

Nr.	Hazard characteristic						Houses		Agriculture				People								
	Year / month	Flood – F	Flood height at home	Flood height in agri land	Duration of flood event	Cause of flood	House damaged (P – partial, C – complete)	Assets destroyed	Livestock died		Crops destroyed		Nr of people affected	Injured - Child, Elder, Disabled, Other (provide numbers)				Died - Child, Elder, Disabled, Other (provide numbers)			
									Type	Nr	Type	Area Hectre		C	E	D	O	C	E	D	O
4													M								
													F								
5													M								
													F								

Cause of flood – R: Heavy/continous rain, C: cyclone rain, O: overflow of embankment, B: breach of embankment, D: People delibrately break embankment, FF: Flash flood, T: tidal flood

C: cattle, B: Baffalo, G: Goat, H: Poultry, P: Pig, Others specify



7. Health impacts of floods

7.1 How many household members experienced the following flood related health problems in the **last major flood**?

Direct Impact	**How many members?** 0=None	**Approx. number of days lost to activity (Total for all members)**
a. Malaria		
b. Dengue		
c. Skin rashes and/or eye infections		
d. Diarrhoea, jaundice, typhoid and other intestinal disorders		
e. Colds or respiratory illness		
f. Stress, depression or other mental problems		
g. Other water related health problem		

8. Preparedness and Early warning system

8.1 Do you observe any variation in tempearture or rainfall over the last 10-15 years: Yes/No

8.2 Do you recive or heard flood warning messages? Yes / No

8.3 If *yes*, what is the source (see codes below) (*more than answer is posible*)?

Message codes: 1. Radio 2. TV 3. Billboards 4. Poster 5. Leaflets 6. Newspaper notices 7. Village leaders 8. Other villagers

9. Other (specify)_____

8.4 Whether you get weather advisory before the cropping season start? Yes / No

8.5 If yes source:

Message codes: 1. Phone 2. Agriculture extension officer 3. Village head 4.

9. Other (specify)_____

8.6 Does your village has a community preparedness plan? Yes / No

8.7 Do you prepare yourself and your family when flooding is imminent? Yes / No.

8.8 If yes, what do you do?
[Enumerator: Don't read list. But prompt three times to check for other measures.]

Measure	**Yes**	**No**
a. Strenghten the house		
b. Store water in safe place		
c. Store food in safe place		
d. Put valuable assets in safe place		
e. Put animals in safe place		
f. Warn others for the flood		
g. Help others with preparations		
h. Help strenghtening the embankment (if there is one)		
i. Other:		
j. Other:		
k.Other:		

9. Coping mechanism and flood management

9.1 What coping mechanism you adapt safegaurd your livelihood (can mark more than one)

Do nothing and take risk		Abandoned agriculture and switch to to occupation	
Plan agricultural activities based on weather warning		Change agriculture crops to suit to flood situations	
Requested government to construct flood protection structures (embankments)		Requested government to demolish embankments	

Others:		Others:	
Others:		Others:	

9.2 Involvement of community in flood management activities

Involvement in flood management meetings along with govt. dept.		Involve in construction of flood protection structures	
Member of local response and emergency group		Others:	
Others:		Others:	

10. Flood risk measures

10.1 Which measures in your opinion should be taken by the community or government to reduce the flood vulnerability? *[Enumerator: Read list first]*

First priority: ____ Second priority: ____ Third priority: ____

Measure codes: 1. Better warnings 2. Constructing dikes 3. More safe areas 4. All weather roads 5. Preparedness plan
6. More relief funds 7. insurance against losses 8. Better medical facilities
9. Other(Specify) _____

11. Self-Assessment of vulnerability.

Thank you very much for all the time you have given. To conclude how would you say the vulnerability to flood of your household is.
11.1 Would you consider your family vulnerable to flooding? ☐ 1. Yes: High; 2. Medium; 3. Low; 0. No, not at all

11.2 If '*High*', please give the major reasons for your vulnerability (tick max. 3 reasons, min. 1 reason):
[Enumerator: wait for reply first. Then check with interviewee the table together]

Because…	**Tick if Yes (max. 3)**
a. there is no embankment to protect my agriculture land and asset	
b. because of the embankment water cannot go out causing flood	
c. we fear to lose our life and asset	
d. we cannot recover from the damage	
e. we cannot afford to getting ill	
f. our house is not flood proof	
g. we do not get support from outside	
h. there is no early warning	
i. it disrupts our life	
j. Other:	
k. Other:	
l. Other:	